United States Department of Agriculture

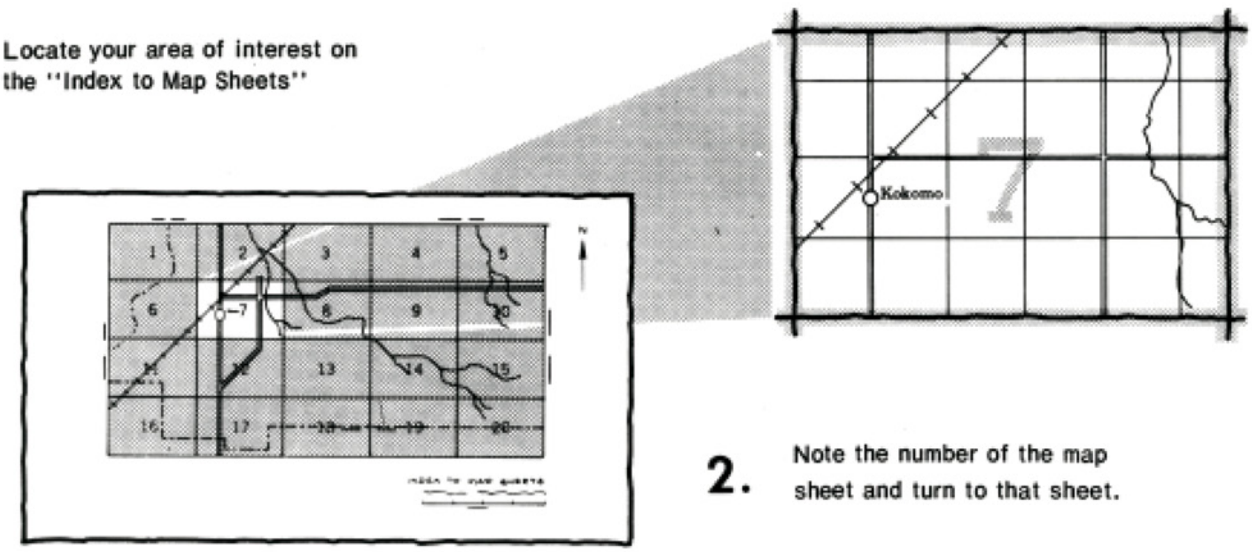
Soil Conservation Service

In Cooperation with Kansas Agricultural Experiment Station

Soil Survey of Greenwood County Kansas

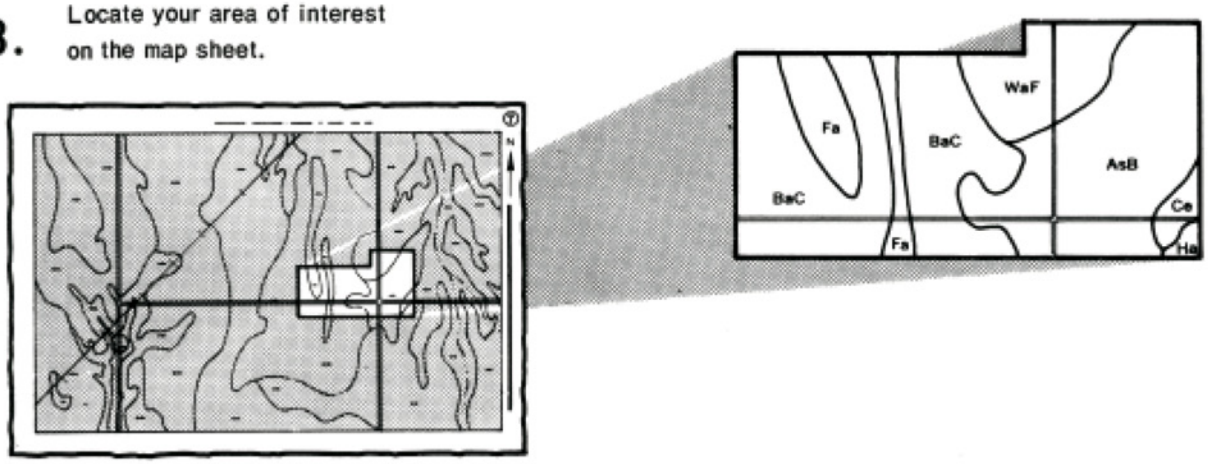
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

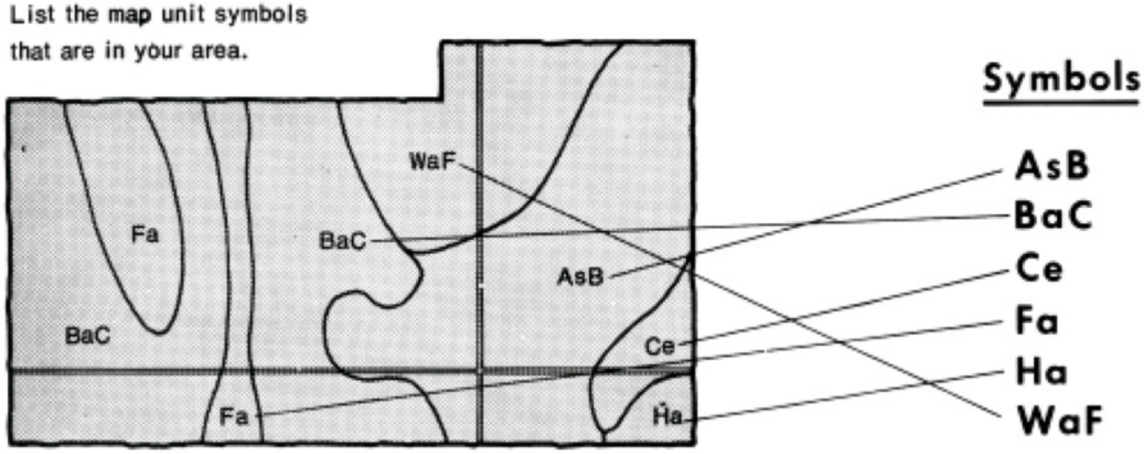


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

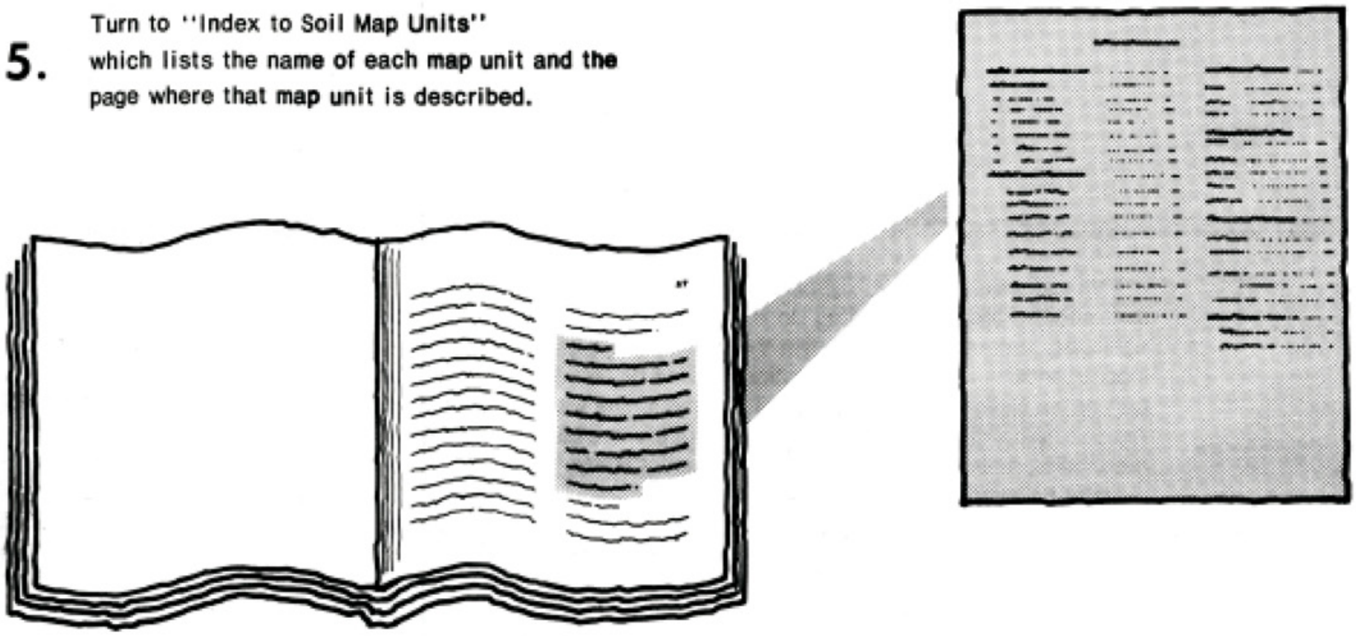


4. List the map unit symbols that are in your area.

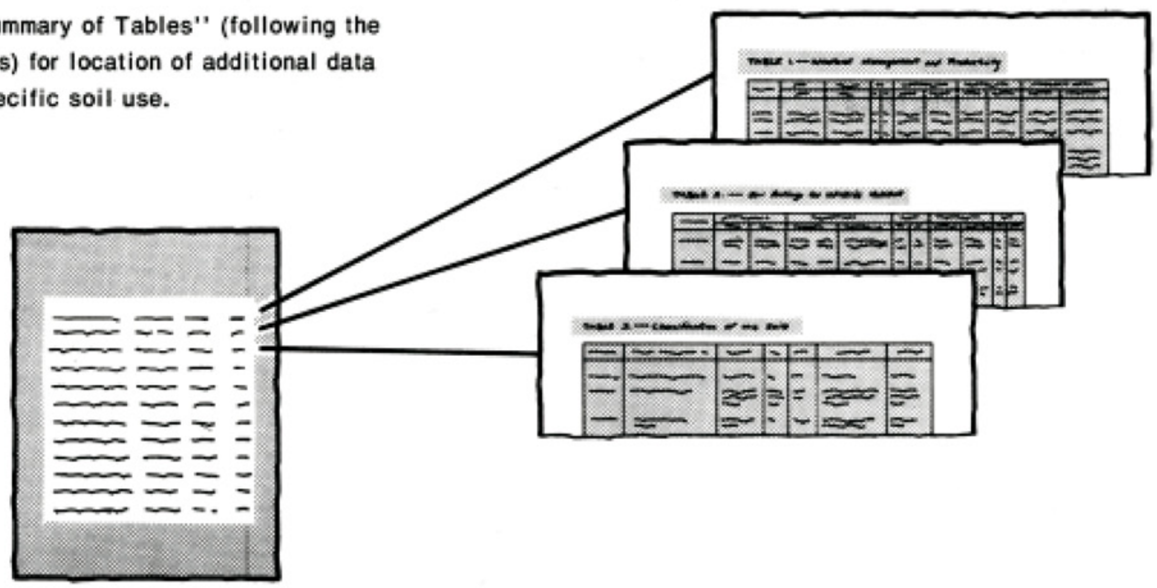


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Greenwood County Conservation District. Major fieldwork was performed in the period 1962-80. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Typical area of the Florence-Labette association. Brushy plants are encroaching on the steeper north-facing slopes.

contents

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Issued October 1982

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foreword

This soil survey contains information that can be used in land-planning programs in Greenwood County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

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State Conservationist
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soil survey of
Greenwood County, Kansas

By Jim R. Fortner, James T. Neill, and Sylvester C. Ekhart,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with the Kansas Agricultural Experiment Station

general nature of the county

GREENWOOD COUNTY is in the southeastern part of Kansas (fig. 1). It has an area of 736,000 acres, or about 1,150 square miles. In 1979, the population was 8,604. In Eureka, the county seat and largest town, the population was 3,389. The county was organized in 1862 by the First Legislature of the Territory of Kansas.

Most of the county is in the Bluestem Hills land resource area. The northeast corner, however, is in the Cherokee Prairies area, and the southeast corner is part of the Cross Timbers area. Generally, the soils are deep or moderately deep, are gently sloping and moderately sloping, and have a clayey subsoil. Elevation ranges from about 875 to 1,660 feet above sea level.

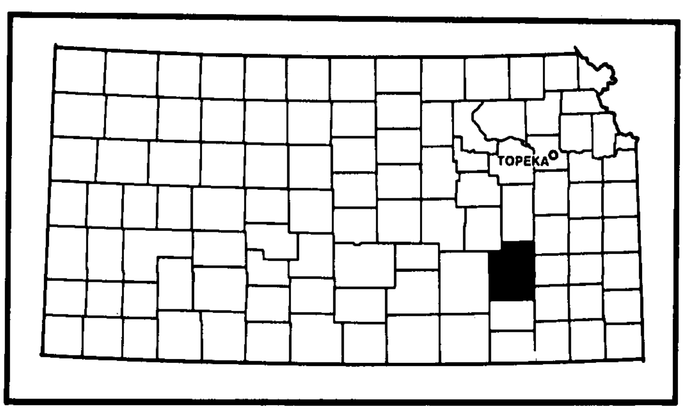

Figure 1.—Location of Greenwood County in Kansas.

Most areas are drained by the Fall and Verdigris Rivers and their tributaries, all of which flow in a southeasterly direction across the county (fig. 2). The Fall River Reservoir and a small part of the Toronto Reservoir are in the southeastern part of the county. Many watershed lakes are in the higher lying areas above these reservoirs.

Ranching, farming, oil production, and related services are the main enterprises in the county. About 83 percent of the acreage is range or pasture, 13 percent is cropland, and about 4 percent is used for woodland, farmsteads, building sites, roads, and other purposes (*7*). Grain sorghum, wheat, soybeans, and hay are the main crops.

This survey updates the soil survey of Greenwood County published in 1914 (*3*). It provides additional information and larger maps, which show the soils in greater detail.

climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Greenwood County is typically continental, as can be expected of a location in the interior of a large land mass in the middle latitudes. It is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air from December through February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops commonly grown in the county. Spring and fall generally are short.

Greenwood County is in the path of a fairly dependable current of moisture-laden air from the Gulf of Mexico. Precipitation is heaviest late in spring and early

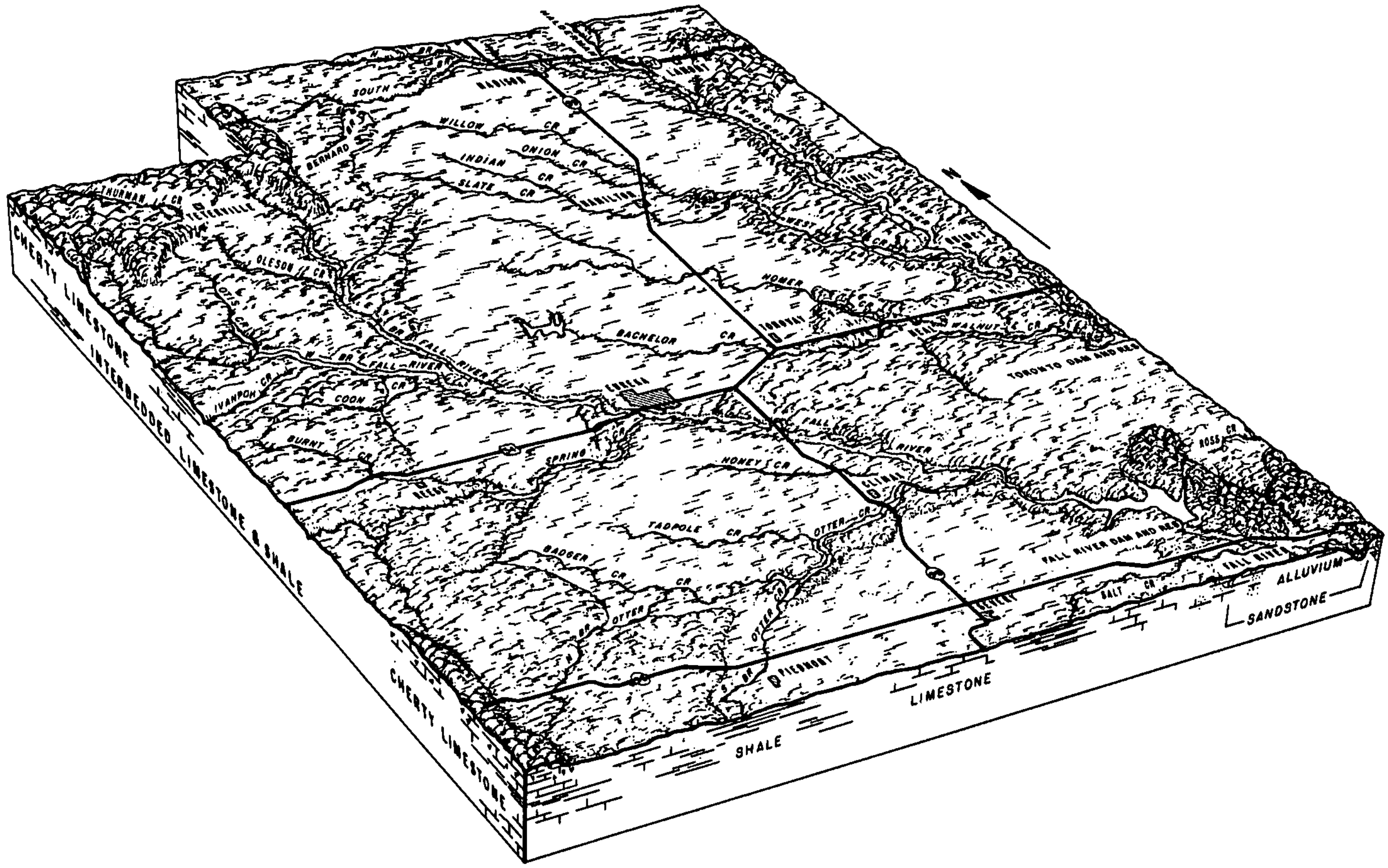

Figure 2.—Relief and drainage pattern in Greenwood County.

in summer. Much of it falls during late-evening or nighttime thunderstorms. Although the total annual precipitation generally is adequate for any crop, its distribution causes problems in some years. Prolonged dry periods of several weeks are not uncommon during the growing season. A surplus of precipitation commonly results in muddy fields, which delay fieldwork.

Tornadoes and severe thunderstorms occur occasionally. They generally are local in extent and of short duration, so that the risk of damage is small. Hail falls during the warmer part of the year. The hailstorms are infrequent, however, and of local extent.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Eureka in the period 1954 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 34.4 degrees F, and the average daily minimum temperature is 22.3 degrees. The lowest temperature on record, which occurred at Fall River on February 13, 1905, is -31 degrees. In summer the average temperature is 77.8 degrees, and the average daily maximum temperature is 90.6 degrees. The highest recorded temperature, which occurred at Eureka on July 18, 1936, is 120 degrees.

The total annual precipitation is 37.65 inches. Of this, 26.25 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 21.23 inches. The heaviest 1-day rainfall during the period of record was 7.70 inches at Virgil on July 12, 1972.

Average seasonal snowfall is about 18 inches. The greatest snow depth at any one time during the period of record was 44 inches. On an average of 15 days, at least 1 inch of snow is on the ground. The snow seldom covers the ground for more than 7 consecutive days.

The sun shines 72 percent of the time possible in summer and 58 percent in winter. The prevailing wind is from the south. Average windspeed is highest in March and April.

natural resources

Soil is the most important natural resource in the county. It provides a growing medium for the grasses grazed by livestock and for cultivated crops.

Other natural resources include petroleum, limestone, cherty gravel, and water. The limestone is quarried for use as roadbuilding material, concrete aggregate, and agricultural lime. The gravel deposits generally are restricted to the areas of Olpe gravelly silt loam, 4 to 15 percent slopes, in the northeastern part of the county. The gravel is used primarily as road rock. Petroleum resources are widespread throughout the county. In 1978, about 1.2 million barrels of oil was produced in the county. The water is supplied mainly by surface impoundments and streams. Rural water districts include a major part of the county.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

soil descriptions

1. Florence-Labette association

Deep and moderately deep, nearly level to strongly sloping, well drained soils that have a dominantly clayey or cherty clay subsoil; on uplands

This association is in an area called the Flint Hills. It consists of soils on the tops and sides of ridges dissected by many drainageways. Slope ranges from 0 to 12 percent.

This association makes up about 4 percent of the county. It is about 60 percent Florence soils, 30 percent Labette soils, and 10 percent minor soils (fig. 3).

The deep Florence soils formed in residuum of cherty limestone on the round tops and sides of ridges. They are gently sloping to strongly sloping. Typically, the surface layer is very dark brown cherty silt loam about 13 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, friable very cherty silty clay loam; the next part is reddish brown and yellowish red, extremely firm very cherty clay; and the lower part is reddish brown, mottled, very firm cherty clay. Cherty limestone is at a depth of about 45 inches.

The moderately deep Labette soils formed in residuum of interbedded limestone and shale on the tops and upper sides of ridges. They are nearly level to moderately sloping. Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone is at a depth of about 31 inches.

Minor in this association are Clime, Dwight, Ivan, and Martin soils. The calcareous Clime and moderately well drained Martin soils are on side slopes and foot slopes. The sodium affected Dwight soils are on broad ridgetops. The deep Ivan soils are on flood plains.

This association is used almost entirely as range. A few areas on foot slopes, however, are used for cultivated crops or hay. The main concern in managing the range is maintaining a vigorous stand of native grasses.

2. Clime-Sogn-Martin association

Deep to shallow, nearly level to moderately steep, moderately well drained to somewhat excessively drained soils that have a clayey or silty subsoil; on uplands

This association is on the tops and sides of ridges dissected by many drainageways and creeks. Slope ranges from 0 to 30 percent.

This association makes up about 40 percent of the county. It is about 50 percent Clime soils, 13 percent Sogn soils, 10 percent Martin soils, and 27 percent minor soils (fig. 4).

The moderately deep, well drained Clime soils formed in residuum of calcareous, clayey shale on side slopes. They are gently sloping to moderately steep. Typically, the surface layer is black, calcareous silty clay about 11 inches thick. The subsoil is dark gray and light olive brown, very firm, calcareous silty clay about 12 inches thick. The substratum is grayish brown, mottled, calcareous silty clay. Calcareous, clayey shale is at a depth of about 33 inches.

The shallow, somewhat excessively drained Sogn soils formed in residuum of limestone on the tops and sides of ridges. They are nearly level to strongly sloping. Typically, the surface layer is black silty clay loam about 7 inches thick. Hard limestone is at a depth of about 7 inches.

The deep, moderately well drained Martin soils formed in residuum of clayey shale or in colluvium. They are on the lower side slopes. They are gently sloping and moderately sloping. Typically, the surface layer is black silty clay loam about 11 inches thick. The subsoil is silty clay about 41 inches thick. The upper part is black and very firm, the next part is very dark gray, mottled, and extremely firm, and the lower part is dark gray, mottled, and extremely firm. The substratum to a depth of about 60 inches is dark brown clay.

Minor in this association are Dwight, Labette, and Ivan soils and rock outcrop. The nearly level and gently sloping Dwight and Labette soils are on ridgetops. Dwight soils are sodium affected, and Labette soils are moderately deep over limestone bedrock. The deep Ivan soils are on narrow flood plains.

This association is used almost entirely as range. Some small areas on foot slopes, however, are used for hay or cultivated crops. Maintaining a vigorous stand of desirable grasses is the main concern in managing the range.

3. Eram-Labette-Kenoma association

Moderately deep and deep, nearly level to moderately sloping, moderately well drained and well drained soils that have a dominantly clayey subsoil; on uplands and high terraces

This association is on the broad tops and sides of ridges commonly dissected by intermittent drainageways. Slope ranges from 0 to 8 percent.

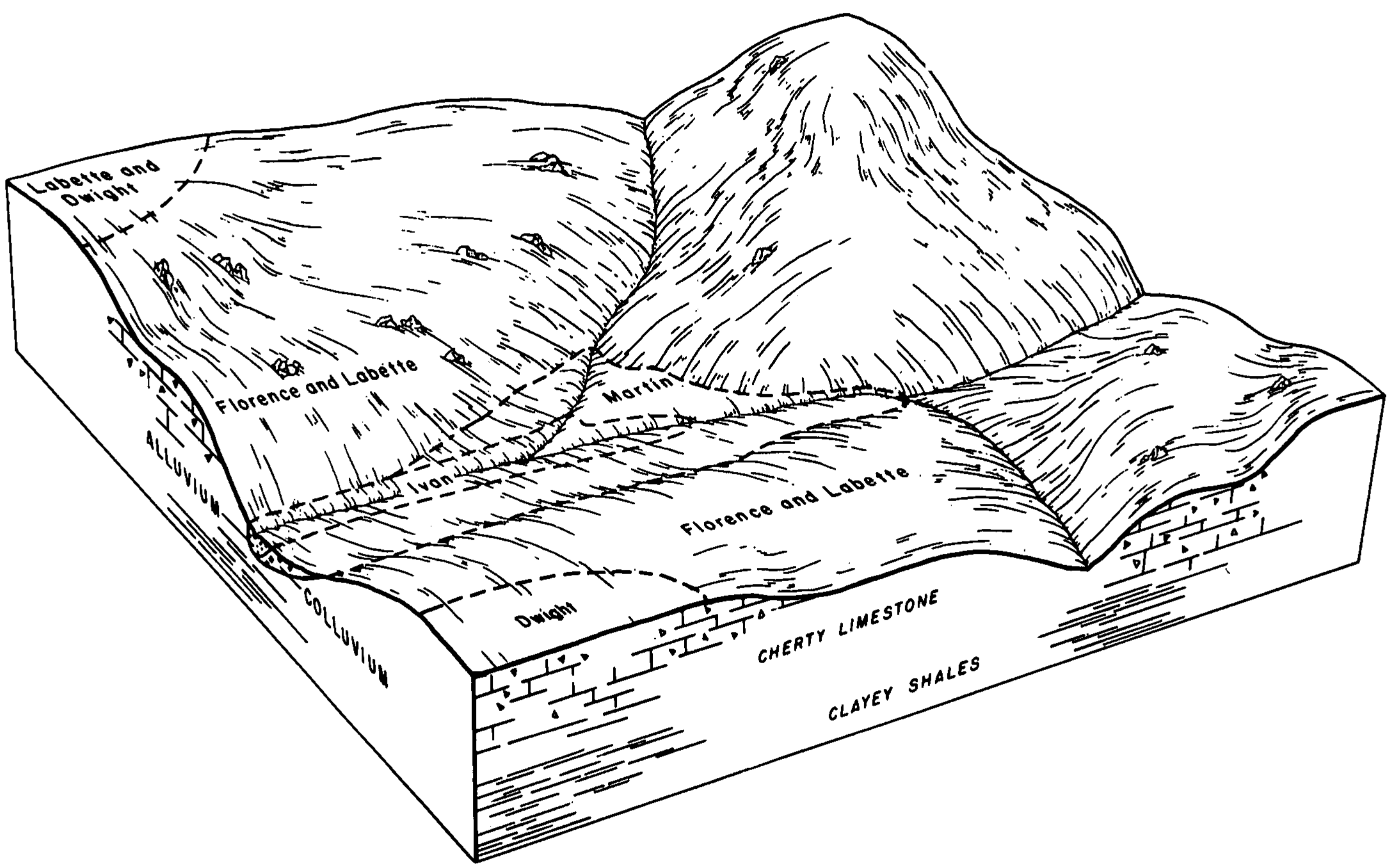

Figure 3.—Typical pattern of soils and parent material in the Florence-Labette association.

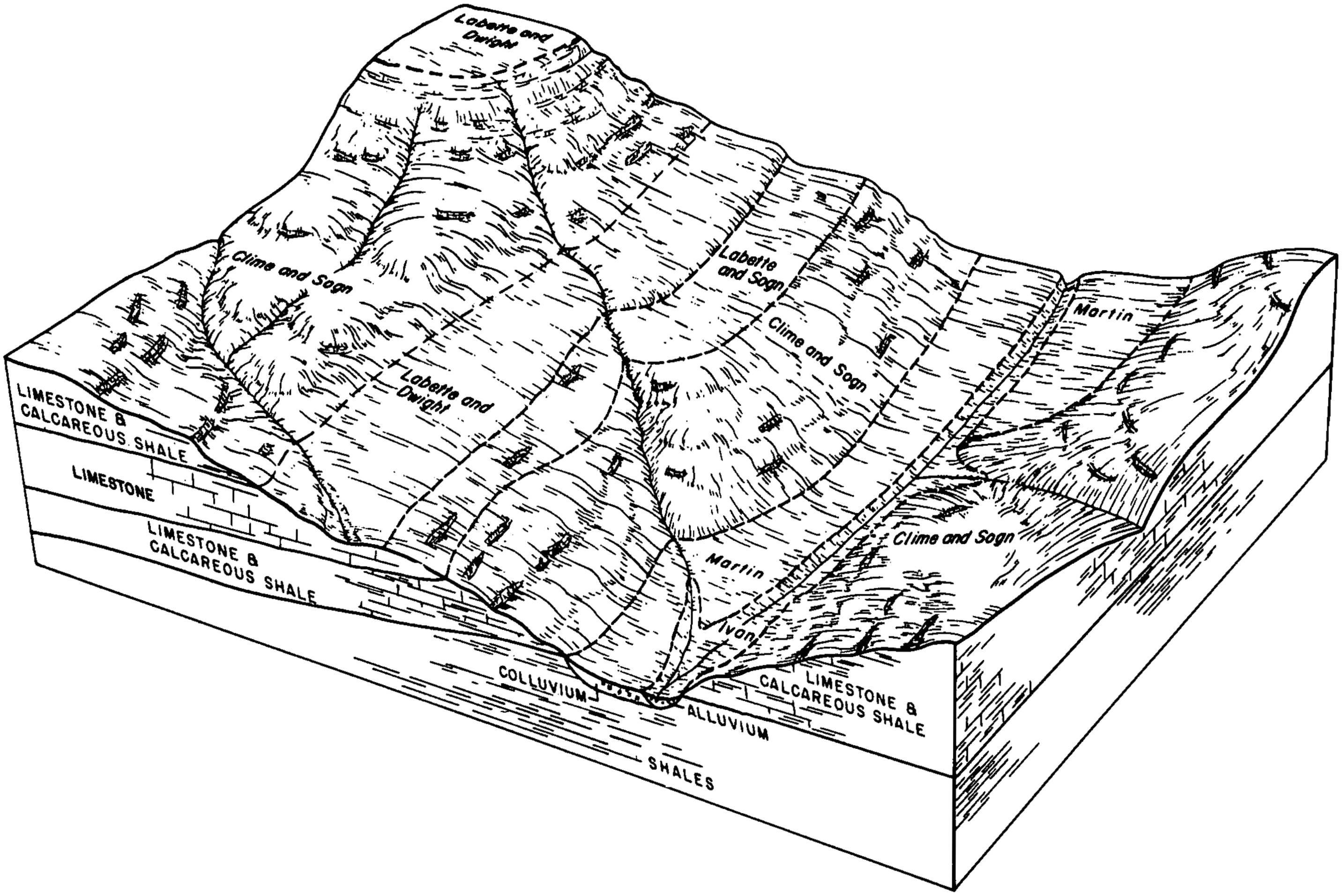

Figure 4.—Typical pattern of soils and parent material in the Clime-Sogn-Martin association.

This association makes up about 35 percent of the county. It is about 20 percent Eram soils, 18 percent Labette soils, 17 percent Kenoma soils, and 45 percent minor soils (fig. 5).

The moderately deep, moderately well drained Eram soils formed in residuum of shale on the tops and sides of ridges. They are gently sloping and moderately sloping. Typically, the surface layer is very dark brown silty clay loam about 10 inches thick. The subsoil is about 23 inches thick. The upper part is very dark grayish brown and olive brown, very firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. Olive brown shale is at a depth of about 33 inches.

The moderately deep, well drained Labette soils formed in residuum of interbedded limestone and clayey shale on the tops and sides of ridges. They are nearly level to moderately sloping. Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, mottled, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone is at a depth of about 31 inches.

The deep, moderately well drained Kenoma soils formed in old alluvial sediments or in residuum of shale. They are gently sloping and are on ridgetops and old high terraces. Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is mottled, very firm silty clay about 22 inches thick. The upper part is very dark brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, mottled silty clay loam.

Minor in this association are Dennis, Ivan, Martin, Reading, Sogn, and Woodson soils. The deep Dennis

and Martin soils are on side slopes and foot slopes. The silty Ivan soils are on flood plains. The deep Reading soils are on terraces. The shallow Sogn soils are on the upper side slopes. The somewhat poorly drained Woodson soils are on broad ridgetops and high terraces.

This association is used mainly for range and cultivated crops, but some areas are used for hay. Controlling erosion and conserving moisture are the main concerns in managing the cropland. Maintaining and improving the stand of desirable grasses are the main concerns in managing the range.

4. Steedman-Dennis-Eram association

Moderately deep and deep, gently sloping to strongly sloping, moderately well drained soils that have a dominantly clayey subsoil; on uplands

This association is on the convex tops and sides of ridges dissected by intermittent drainageways. Slope ranges from 1 to 12 percent.

This association makes up about 9 percent of the county. It is about 65 percent Steedman soils, 15 percent Dennis soils, 12 percent Eram soils, and 8 percent minor soils (fig. 6).

The moderately deep Steedman soils formed in material weathered from shale. They are moderately sloping on ridgetops and strongly sloping on side slopes. Typically, the surface layer is very dark grayish brown stony loam about 8 inches thick. The subsoil is mottled, very firm silty clay about 22 inches thick. The upper part is reddish brown, and the lower part is dark yellowish brown. Clayey shale is at a depth of about 30 inches.

The deep Dennis soils formed in residuum of shale or in colluvium. They are gently sloping and moderately sloping and are on side slopes and foot slopes. Typically, the surface layer is very dark brown silt loam about 12 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, firm silty clay loam; the next part is brown and dark yellowish brown, mottled, firm and very firm silty clay; and the lower part is yellowish brown, mottled, extremely firm silty clay.

The moderately deep Eram soils formed in residuum of shale on the tops and sides of ridges. They are gently sloping and moderately sloping. Typically, the surface layer is very dark brown silty clay loam about 10 inches thick. The subsoil is about 23 inches thick. The upper

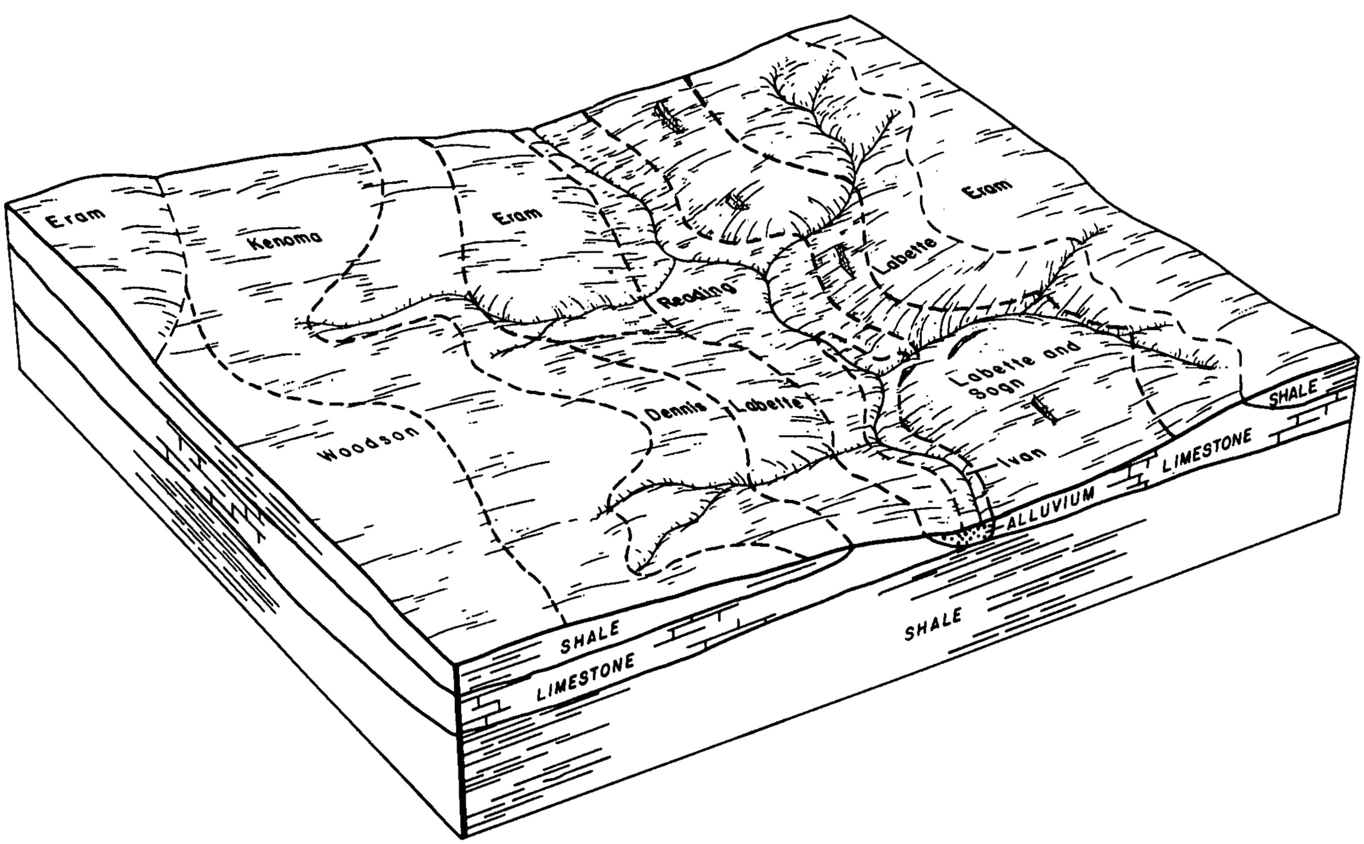

Figure 5.—Typical pattern of soils and parent material in the Eram-Labette-Kenoma association.

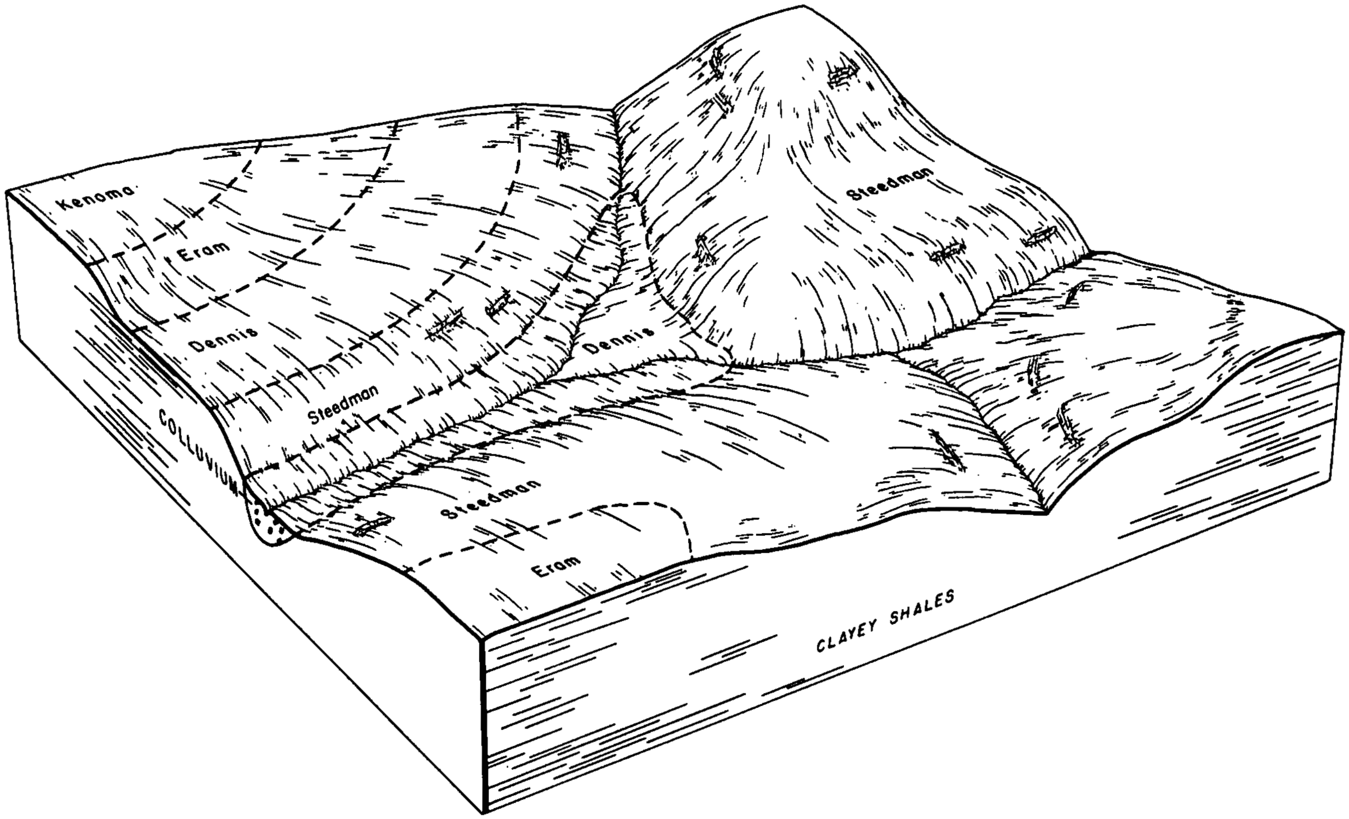

Figure 6.—Typical pattern of soils and parent material in the Steedman-Dennis-Eram association.

part is very dark grayish brown and olive brown, very firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. Olive brown shale is at a depth of about 33 inches.

Minor in this association are Kenoma, Clime, Ivan, and Niotaze soils. The deep Kenoma soils are on broad ridgetops and old high terraces. The calcareous Clime soils are on side slopes. The silty Ivan soils are on flood plains. The moderately deep, somewhat poorly drained Niotaze soils are on the tops and sides of ridges.

This association is used mainly as range. Some areas on ridgetops and foot slopes, however, are used for hay or cultivated crops. The main concern in managing the range is maintaining a vigorous stand of desirable grasses.

5. Niotaze-Darnell-Steedman association

Moderately deep and shallow, nearly level to steep, somewhat poorly drained to well drained soils that have a clayey or loamy subsoil; on uplands

This association is on the narrow tops and sides of ridges commonly dissected by intermittent drainageways. In some areas stones and boulders are on the surface. Slope ranges from 0 to 35 percent.

This association makes up about 1 percent of the county. It is about 60 percent Niotaze soils, 15 percent Darnell soils, 10 percent Steedman soils, and 15 percent minor soils.

The moderately deep, somewhat poorly drained Niotaze soils formed in residuum of shale interbedded with sandstone on the narrow tops and sides of ridges. They are gently sloping to steep. Typically, the surface layer is dark brown loam about 3 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark reddish brown, very firm clay, and the lower part is dark reddish brown, mottled, very firm silty clay. Clayey shale is at a depth of about 27 inches.

The shallow, well drained Darnell soils formed in residuum of sandstone on the tops and sides of ridges. They are nearly level to steep. Typically, the surface layer is very dark grayish brown fine sandy loam about 6 inches thick. The subsoil is brown, very friable fine sandy loam about 10 inches thick. Sandstone is at a depth of about 16 inches.

The moderately deep, moderately well drained Steedman soils formed in material weathered from shale on the tops and sides of ridges. They are moderately sloping. Typically, the surface layer is very dark grayish brown stony loam about 8 inches thick. The subsoil is mottled, very firm silty clay about 22 inches thick. The upper part is reddish brown, and the lower part is dark yellowish brown. Clayey shale is at a depth of about 30 inches.

Minor in this association are Dennis and Eram soils and numerous sandstone outcrops. The deep Dennis soils are on foot slopes. The moderately deep Eram soils are on the tops and sides of ridges.

This association is used mainly as range. Some areas on foot slopes and along drainageways, however, are used for cultivated crops. Many areas support blackjack oak and post oak. The main concern in managing the range is maintaining a vigorous stand of desirable grasses.

6. Olpe-Kenoma association

Deep, gently sloping to strongly sloping, well drained and moderately well drained soils that have a dominantly clayey or gravelly and clayey subsoil; on uplands

This association is on upland knolls and ridges. Slope ranges from 1 to 15 percent.

This association makes up about 2 percent of the county. It is about 60 percent Olpe soils, 30 percent Kenoma soils, and 10 percent minor soils.

The well drained Olpe soils formed in old gravelly alluvium. They are moderately sloping on the round tops of ridges and strongly sloping on side slopes. Typically, the surface layer is dark brown gravelly silt loam about 13 inches thick. The subsoil extends to a depth of more than 60 inches. It is mottled below a depth of 50 inches. The upper part is dark brown, firm very gravelly silty clay loam; the next part is reddish brown, very firm very gravelly silty clay; and the lower part is dark red, very firm gravelly and very gravelly clay.

The moderately well drained Kenoma soils formed in old alluvial sediments or in residuum of shale. They are gently sloping and are on ridgetops. Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is mottled, very firm silty clay about 22 inches thick. The upper part is very dark brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, mottled, firm silty clay loam.

Minor in this association are the moderately deep Labette and Eram soils. Labette soils are on the tops and upper sides of ridges. Eram soils are on side slopes.

This association is used mainly as range. Some areas, however, are used for hay and a few for cultivated crops. The main management needs in the areas used as range are measures that prevent the invasion of undesirable grasses and brush.

7. Reading-Ivan-Chase association

Deep, nearly level, well drained and somewhat poorly drained soils that have a silty or clayey subsoil; on low terraces and flood plains

This association is on bottom land along the major streams in the county. The soils are subject to flooding. Slope ranges from 0 to 2 percent.

This association makes up about 9 percent of the county. It is about 52 percent Reading soils, 26 percent Ivan soils, 14 percent Chase soils, and 8 percent minor soils.

The well drained Reading soils formed in silty alluvium on terraces. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is very dark brown, friable silt loam about 5 inches thick. The subsoil is firm silty clay loam about 31 inches thick. The upper part is very dark grayish brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silty clay loam.

The well drained, calcareous Ivan soils formed in silty alluvium on flood plains. Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is very dark grayish brown, friable silt loam about 22 inches thick. The substratum to a depth of about 60 inches is dark brown silt loam.

The somewhat poorly drained Chase soils formed in alluvium on low terraces. Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black, friable silty clay loam about 7 inches thick. The subsoil is about 31 inches thick. It is mottled below a depth of 30 inches. The upper part is black, firm silty clay loam, and the lower part is very dark gray, very firm and extremely firm silty clay. The substratum to a depth of about 60 inches is dark gray, mottled silty clay loam.

Minor in this association are the poorly drained Osage soils in slightly concave areas on flood plains. These soils are clayey throughout.

This association is used almost entirely for cultivated crops and hay, but a few small areas are used as woodland or range. The main crops are corn, soybeans, sorghum, wheat, and alfalfa. The main concerns of management are controlling flooding and maintaining fertility and good tilth. A surface drainage system is needed in some areas of the Chase soils.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Dennis silt loam, 1 to 4 percent slopes, is one of several phases in the Dennis series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Florence-Labette complex, 2 to 12 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

At—Aquents, flooded. These nearly level, somewhat poorly drained and poorly drained soils are in borrow pits from which the overlying soil material has been removed for use in the construction of roads and railroad beds. In nearly all areas they are on bottom land and are frequently flooded. The pits vary in depth, generally are rectangular, and range from 5 to 60 acres in size.

These soils are silty or clayey throughout. They show very little evidence of soil formation.

Because of the frequent flooding, these soils are severely limited as sites for farm uses and generally are unsuitable as sites for buildings and sanitary facilities. Most areas are used as habitat for wildlife. The vegetation is mainly water tolerant grasses and cottonwood trees. Some areas are covered with water during part of the year.

No capability class or subclass is assigned to these soils.

Ca—Chase silty clay loam. This deep, nearly level, somewhat poorly drained soil is on low terraces. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black, friable silty clay loam about 7 inches thick. The subsoil is about 31 inches thick. It is mottled below a depth of 30 inches. The upper part is black, firm silty clay loam, and the lower part is very dark gray, very firm and extremely firm silty clay. The substratum to a depth of about 60 inches is dark gray, mottled silty clay loam. In some areas the surface layer is silty clay. In other areas the subsoil is calcareous.

Included with this soil in mapping are small areas of the well drained Reading and Ivan soils, which make up 5 to 10 percent of the unit. Reading soils are on the higher terraces and are rarely flooded. Ivan soils are near the stream channels.

Permeability is slow in the Chase soil, and available water capacity is high. Surface runoff is slow. A perched seasonal high water table is at a depth of 2 to 4 feet during spring. The shrink-swell potential is high in the subsoil. Tilth is good.

Most areas are used for cultivated crops, but a few are used for tame grass pasture. This soil is well suited to corn, soybeans, sorghum, wheat, and alfalfa. The main concern of management is the crop damage caused by floodwater. Tillage is sometimes delayed because of the wetness. Drainage ditches help to remove excess surface water. Keeping tillage at a minimum and leaving crop residue on the surface help to prevent deterioration of tilth and fertility. Crop rotations help to control weeds, plant diseases, and insect carryover.

This soil is well suited to tame grasses for hay or pasture. Overgrazing and haying or grazing when the soil is too wet, however, cause surface compaction and poor tilth. Overgrazing also reduces the vigor and retards the growth of the grasses. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. Applications of fertilizer increase forage production.

A few small areas are used as native woodland. This soil is well suited to trees. Because of the wetness, equipment can be used more easily if the trees are harvested in fall or winter, when the amount of precipitation is low. Proper site preparation and controlled burning, spraying, or cutting reduce the rate of seedling mortality and control plant competition. Important commercial species include black walnut, pecan, eastern cottonwood, green ash, bur oak, and hackberry.

This soil generally is unsuitable as a site for buildings because of the flooding.

The capability subclass is IIw.

Ce—Clime stony silty clay loam, 20 to 30 percent slopes. This moderately deep, moderately steep, well drained soil is on side slopes in the uplands. It occurs as long and narrow areas that follow the bluffs along the larger creeks. The areas range from 20 to 300 acres in size. Many scattered limestone rocks are on the surface (fig. 7). They are 1 to 2 feet in diameter and 10 to 30 feet apart.

Typically, the surface layer is very dark grayish brown, calcareous stony silty clay loam about 9 inches thick. The subsoil is very dark grayish brown, firm, calcareous silty clay loam about 9 inches thick. The substratum is olive brown, calcareous shaly silty clay loam. Calcareous shale is at a depth of about 30 inches. In some areas the depth to bedrock is less than 20 inches. In a few areas the soil contains chert fragments.

Permeability is slow, and available water capacity is low. Surface runoff is rapid. The shrink-swell potential is moderate. Root penetration is restricted by the shale at a depth of about 30 inches.

Nearly all areas are used as range. Because of a severe hazard of erosion, the slope, and the many stones on the surface, this soil is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is little bluestem, big bluestem, and sideoats grama. Trees and brush have invaded in many areas. As a result, brush control is needed to increase forage production. Prescribed burning late in spring helps to control the woody plants. A uniform distribution of grazing is a concern of management. Many areas are grazed only infrequently because of the slope and the many stones on the surface. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing.

This soil generally is unsuited to building site development because of the moderately steep slope.

The capability subclass is VIIe.

Cm—Clime silty clay, 3 to 7 percent slopes. This moderately sloping, moderately deep, well drained soil is on the tops and sides of ridges in the uplands. Individual areas are irregular in shape and range from 10 to more than 300 acres in size.

Typically, the surface layer is black, calcareous silty clay about 11 inches thick. The subsoil is olive brown, firm, calcareous silty clay about 9 inches thick. The substratum is grayish brown and light yellowish brown, calcareous silty clay. Clayey shale is at a depth of about 32 inches. In some areas the soil is noncalcareous throughout. In other areas the subsoil is redder.

Included with this soil in mapping are small areas of the deep Martin soils on the lower side slopes. These soils make up about 10 percent of the unit.

Permeability is slow in the Clime soil, and available water capacity is low. Surface runoff is rapid. The shrink-swell potential is moderate. The surface layer is firm and cannot be easily tilled. Root penetration is restricted by the clayey shale at a depth of about 32 inches.

Most areas are used as native range. A few, however, are used for cultivated crops, and some are abandoned

Figure 7.—Typical area of Clime stony silty clay loam, 20 to 30 percent slopes.

cropland or have been reseeded to grasses. The main crops are wheat and grain sorghum. This soil is poorly suited to cultivated crops because erosion is a hazard. Minimum tillage, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material improves fertility and tilth. The crop residue also conserves moisture by increasing the infiltration rate and reducing the runoff rate.

This soil is best suited to tame or native grasses for hay or grazing. The native vegetation dominantly is little bluestem, big bluestem, and sideoats grama. In overused areas these grasses are replaced by less productive grasses and by weeds. An adequate plant cover and ground mulch increase the moisture supply by reducing the runoff rate. Range seeding is needed to restore the productivity of abandoned cropland. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, rotation grazing, and restricted use during prolonged wet periods help to keep the range in good condition. Applications of fertilizer increase forage production in the areas of tame grasses.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Although the depth to bedrock is a limitation on sites for dwellings with basements, the rock is soft and can easily be excavated. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Mainly because of the depth to bedrock, this soil generally is unsuited to septic tank absorption fields and is poorly suited to sewage lagoons. The deep included soils on the lower side slopes are better suited to lagoons.

The capability subclass is IVe.

Cs—Clime-Sogn complex, 5 to 20 percent slopes. These moderately sloping and strongly sloping soils are on the tops and sides of ridges on uplands that generally are dissected by many drainageways. Very narrow bands of exposed limestone are common. The moderately deep, well drained Clime soil generally is in the more sloping areas, and the shallow or very shallow, somewhat excessively drained Sogn soil is in the less sloping areas. Individual areas are irregular in shape and range from 20 to a few thousand acres in size. They are about 60 to 70 percent Clime soil and 15 to 20 percent Sogn soil. The two soils occur as closely intermingled alternating bands that are too narrow to be mapped separately.

Typically, the Clime soil has a black, calcareous silty clay surface layer about 11 inches thick. The subsoil is dark gray and light olive brown, very firm, calcareous silty clay about 12 inches thick. The substratum is grayish brown, calcareous silty clay. Clayey, calcareous shale is at a depth of about 33 inches. In some areas the soil is noncalcareous throughout. In other areas the subsoil is redder.

Typically, the Sogn soil has a black silty clay loam surface layer about 7 inches thick. It is underlain by hard limestone at a depth of about 7 inches.

Included with these soils in mapping are small areas of rock outcrop and of the noncalcareous Dwight, Labette, and Martin soils. These included areas make up 5 to 15 percent of the unit. The nearly level Dwight soils are on ridgetops. They are affected by sodium salts. Labette soils are 20 to 40 inches deep over limestone. They are redder than the Clime and Sogn soils. They generally are higher on the landscape than the Sogn soil. The deep Martin soils are on the lower side slopes. The rock outcrop is on breaks, in the steeper areas, and on side slopes, generally below the Sogn soil.

Permeability is slow in the Clime soil and moderate in the Sogn soil. Available water capacity is low in the Clime soil and very low in the Sogn soil. Surface runoff is rapid on both soils. Root penetration is restricted by the clayey shale at a depth of about 33 inches in the Clime soil and by the limestone at a depth of about 7 inches in the Sogn soil. The shrink-swell potential is moderate in both soils.

Nearly all areas are used as range. Because of a severe hazard of erosion on both soils and the shallowness to limestone in the Sogn soil, this map unit generally is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is little bluestem, big bluestem, and sideoats grama. The sideoats grama is more common on the shallow or very shallow Sogn soil than on the Clime soil. In severely overgrazed areas, the range has been invaded by annual bromegrass, annual broomweed, and other less desirable plants. An adequate plant cover conserves moisture by reducing the runoff rate. Brush control is needed in many areas. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition and help to prevent the encroachment of brush.

The Clime soil is poorly suited to local roads and streets. Low strength is the main limitation. Also, the slope is a limitation in the steeper areas. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Also, providing coarser grained base material helps to ensure better performance. The less sloping areas are the better sites. Building the roads on the contour helps to prevent excessive erosion.

Because of the depth to bedrock and the slope, the Clime soil is poorly suited to dwellings. The deeper, less sloping soils on foot slopes are better sites.

Because of the slow permeability and the depth to bedrock, the Clime soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. The deeper, less sloping soils on foot slopes are better sites for lagoons. If the less sloping areas are selected, less leveling and banking will be needed during construction.

The Sogn soil generally is unsuited to building site development because it is shallow or very shallow over bedrock.

The capability subclass is VIe.

De—Dennis silt loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops, side slopes, and low knolls in the uplands. Individual areas are irregular in shape and range from 10 to more than 300 acres in size.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is brown, mottled, firm silty clay loam, and the lower part is yellowish brown, mottled, very firm silty clay. In some areas shale is within a depth of 40 inches. In other areas the upper part of the subsoil is silty clay.

Permeability and surface runoff are slow. Available water capacity is high. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. Tilth is good. The shrink-swell potential is high in the subsoil.

About half the acreage is cultivated. The rest is used mainly as range, but a few areas are used as tame grass pasture. This soil is well suited to wheat, sorghum, soybeans, and alfalfa. Erosion is a hazard if cultivated

crops are grown. Contour farming, terraces, grassed waterways, and minimum tillage, however, help to prevent excessive soil loss. Returning crop residue to the soil helps to prevent deterioration of tilth and fertility.

This soil is suited to range. The native vegetation dominantly is big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, western ragweed, and Baldwin ironweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition. Applications of fertilizer increase forage production in areas of tame pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow permeability and the wetness, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping generally is needed.

The capability subclass is IIe.

Dn—Dennis silt loam, 4 to 7 percent slopes. This deep, moderately sloping, moderately well drained soil is on upland side slopes and foot slopes. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, firm silty clay loam; the next part is brown and dark yellowish brown, mottled, firm and very firm silty clay; and the lower part is yellowish brown, mottled, extremely firm silty clay. In a few small eroded areas, the surface layer is silty clay loam. In some areas shale is within a depth of 40 inches.

Permeability is slow, and available water capacity is high. Surface runoff is medium. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. Tilth is good. The shrink-swell potential is high in the subsoil.

Most areas are used as range or tame grass pasture. The rest are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, alfalfa, and soybeans. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, grassed waterways, and minimum tillage, however, help prevent excessive soil loss. Returning crop residue to the soil helps to prevent deterioration of tilth and fertility.

This soil is suited to range. The native vegetation dominantly is big bluestem, little bluestem, switchgrass, and indiangrass. In overused areas the range has been invaded by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland. Early mowing of hay allows the native grasses to recover before the first frost. Timely grazing and haying and applications of fertilizer are beneficial in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow permeability and the wetness, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping generally is needed.

The capability subclass is IIIe.

Ds—Dennis silty clay loam, 2 to 6 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on side slopes, foot slopes, and terrace breaks. In some areas it is dissected by many gullies. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown silty clay loam about 6 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, firm silty clay loam; the next part is brown and dark yellowish brown, mottled, very firm silty clay; and the lower part is yellowish brown and grayish brown, mottled, very firm silty clay. In some areas the surface layer is thicker and less clayey. In other areas shale is at a depth of 20 to 40 inches.

Permeability is slow, and available water capacity is high. Surface runoff is medium. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early

in spring. The shrink-swell potential is high in the subsoil. Tilth is fair.

Most areas are used for cultivated crops, but some are used for tame grass pasture or have been reseeded to native grass. This soil is moderately well suited to grain sorghum, wheat, alfalfa, and soybeans. If cultivated crops are grown, further erosion is a hazard. It can be controlled, however, by grassed waterways, terraces, and contour farming. Minimizing tillage and returning crop residue to the soil improve tilth and increase the infiltration rate.

This soil is suited to range, pasture, and hay. The major concerns in managing the range or pasture are erosion and low forage production on abandoned cropland. An adequate plant cover reduces the runoff rate, helps to prevent excessive soil loss, and increases the moisture supply. Range seeding is needed to restore the productivity of abandoned cropland. Proper stocking rates, timely deferment of grazing, and brush control help to keep the range in good condition. Applications of fertilizer are beneficial in the areas of tame grasses. Land shaping is needed in areas where the soil is too gullied for seeding or haying.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow permeability and the wetness, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping generally is needed.

The capability subclass is IIIe.

Dw—Dwight silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on upland ridgetops and foot slopes. Depressions less than 1 foot deep and less than 20 feet in diameter are common. They are subject to ponding. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is black silt loam about 4 inches thick. In many cultivated areas it has been mixed with the upper part of the subsoil. The subsoil is extremely firm clay about 28 inches thick. The upper part is black, the next part is very dark grayish brown, and the lower part is dark brown. The substratum is dark brown silty clay. Hard limestone is at a depth of about 44 inches. In some areas the surface layer is thicker.

Included with this soil in mapping are small areas of the well drained Labette and somewhat poorly drained Zaar soils. These soils make up 5 to 10 percent of the unit. Their positions on the landscape are similar to those of the Dwight soil. Labette soils are 20 to 40 inches deep over limestone. The surface layer of Zaar soils is more clayey than that of the Dwight soil.

Permeability is very slow in the Dwight soil, and available water capacity is low. Surface runoff is medium. The shrink-swell potential is high in the subsoil. The content of sodium in the subsoil adversely affects the growth of most plants. The soil does not absorb moisture easily or release it readily to plants.

Most areas are used as range, but some are abandoned cropland or have been reseeded to tame grasses. Because of the low available water capacity and the excess sodium in the subsoil, this soil is poorly suited to cultivated crops and to tame grass pasture. It is best suited to native range. If it is in good condition, the range supports a mixture of tall, mid, and short grasses. Overused areas are dominated by short grasses, such as buffalograss and blue grama. Also, they have been invaded by weeds, including prairie threeawn, annual broomweed, and dotted gayfeather. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, restricted use during wet periods, and rotation grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

Because of the extent of the shorter grasses, many areas of this soil are used as booming ground by prairie chickens. The nesting habitat for the prairie chickens can be improved by maintaining a good stand of tall grasses in the nearby areas.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the very slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is only moderately well suited to sewage lagoons because the depth to bedrock is a limitation. The areas where the soil is deepest over bedrock are the best sites for lagoons.

The capability subclass is IVs.

Eb—Eram silty clay loam, 1 to 4 percent slopes. This moderately deep, gently sloping, moderately well drained soil is on the tops and sides of upland ridges. Individual areas are irregular in shape and range from 10 to more than 300 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 10 inches thick. The subsoil is about 23 inches thick. The upper part is very dark grayish brown and olive brown, very firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. Olive brown shale is at a depth of about 33 inches. In some areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are areas of soils that have a loam subsoil and are moderately deep over sandy shale or sandstone. These soils are in positions on the landscape similar to those of the Eram soil. Also included are some small areas of the sodium affected Dwight soils on the lower side slopes. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Eram soil, and available water capacity is low. Surface runoff is medium. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. The shrink-swell potential is high in the subsoil. Tilth is good. Root penetration is restricted by the shale at a depth of about 33 inches.

Most of the acreage is used as range. The rest is used for cultivated crops or for pasture. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Erosion is the principal hazard if cultivated crops are grown. Contour farming, terraces, grassed waterways, and minimum tillage help to prevent excessive runoff and soil loss. Soil depth should be considered when a terrace system is designed. In a few areas where terraces have been built, the root zone is severely restricted because most of the soil overlying the bedrock has been removed. Returning crop residue to the soil helps to prevent deterioration of tilth and fertility and increases the infiltration rate.

This soil is suited to range. The native vegetation dominantly is big bluestem, little bluestem, switchgrass, and indiangrass. In overused areas the range has been invaded by less desirable plants, such as Baldwin ironweed and western ragweed. Invasion of brushy plants, such as sumac, blackberry, and eastern redcedar, is an additional concern of management. Timely burning helps to control the brushes and trees. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland. Early mowing of hay allows the native grasses to recover before the first frost. Timely grazing and haying and applications of fertilizer are beneficial in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the depth to bedrock, the wetness, and the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock and the wetness. Suitable sites for lagoons generally are available in the areas where the depth to bedrock is more than 40 inches.

The capability subclass is IIIe.

Ec—Eram silty clay loam, 4 to 7 percent slopes. This moderately deep, moderately sloping, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 500 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 11 inches thick. The subsoil is about 13 inches thick. The upper part is dark grayish brown, firm silty clay loam, and the lower part is light olive brown, mottled, firm silty clay. The substratum is grayish brown, mottled shaly silty clay. Olive brown shale is at a depth of about 33 inches. In some areas the depth to bedrock is more than 40 inches. In other areas the soil is calcareous. In a few small eroded areas, the surface layer is dark grayish brown.

Included with this soil in mapping are small areas of soils that have a loam subsoil and are moderately deep over sandy shale or sandstone. These soils make up 5 to 10 percent of the unit. They are in positions on the landscape similar to those of the Eram soil.

Permeability is slow in the Eram soil, and available water capacity is low. Surface runoff is rapid. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. The shrink-swell potential is high in the subsoil. The surface layer is firm and cannot be easily tilled. Root penetration is restricted by the shale at a depth of about 33 inches.

Most areas are used as native range. A few, however, are cultivated or have been reseeded to tame grasses, and some are abandoned cropland. This soil is moderately well suited to wheat and grain sorghum. Erosion is a hazard if cultivated crops are grown. It can be controlled, however, by contour farming, terraces, grassed waterways, and minimum tillage. Soil depth should be considered when a terrace system is designed. In a few areas where terraces have been built, the root zone is severely restricted because most of the soil overlying the bedrock has been removed. Returning

crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is best suited to range and pasture. In the areas used as range, the native vegetation dominantly is big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, western ragweed, and Baldwin ironweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, restricted use during prolonged wet periods, and rotation grazing help to keep the range in good condition. Invasion of brushy plants, such as sumac, blackberry, and eastern redcedar, is a concern of management. Timely burning helps to control the trees and brushes. Range seeding is needed to restore the productivity of abandoned cropland. Timely grazing and haying and applications of fertilizer are beneficial in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the depth to bedrock, the wetness, and the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock and the wetness. Suitable sites for lagoons generally are available in the areas where the depth to bedrock is more than 40 inches. Some land shaping may be needed to keep surface water away from the lagoon.

The capability subclass is IVe.

Eh—Eram silty clay loam, 3 to 7 percent slopes, eroded. This moderately deep, moderately sloping, moderately well drained soil is on side slopes and knolls in the uplands. In some areas it is dissected by many gullies. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 15 inches thick. The upper part is very dark grayish brown, mottled, very firm silty clay. Clayey shale is at a depth of about 21 inches. In some areas the surface layer is thicker. In other areas the depth to shale is more than 40 inches.

Included with this soil in mapping are small areas of soils that have a loam subsoil. These soils make up 5 to 10 percent of the unit. They are in positions on the landscape similar to those of the Eram soil.

Permeability is slow in the Eram soil, and available water capacity is low. Surface runoff is rapid. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. The shrink-swell potential is high in the subsoil. The surface layer is firm, and tilth is poor. Root penetration is restricted by the shale at a depth of about 21 inches.

Many areas support tame and native grasses and are used for grazing. A few are used for cultivated crops. This soil is best suited to pasture and range. A cover of grasses helps to control erosion. Establishing grasses is difficult, however, because of the deep gullies and the content of clay in the surface layer. Land shaping commonly is needed to smooth the gullies. Proper stocking rates, rotation grazing, and timely deferment of grazing help to keep the pasture or range in good condition and control erosion. Applications of fertilizer increase forage production in the areas used as tame grass pasture.

Because of the hazard of further erosion and the low available water capacity, this soil is poorly suited to cultivated crops. It is better suited to close growing crops, such as wheat, than to other crops. Drought significantly reduces productivity. Establishing grassed waterways, terracing, farming on the contour, and returning crop residue to the soil help to control erosion. The crop residue also improves tilth. No-till planting and minimum tillage reduce the susceptibility to erosion during the winter. Barnyard manure, green manure, and commercial fertilizers improve fertility.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the depth to bedrock, the wetness, and the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock and the wetness. Suitable sites for lagoons generally are available in the areas where the depth to bedrock is more than 40 inches. Some land shaping may be needed to keep surface water away from the lagoon.

The capability subclass is IVe.

Ft—Florence-Labette complex, 2 to 12 percent slopes. These gently sloping to strongly sloping, well drained soils are on uplands that in some areas are dissected by many deeply entrenched drainageways. The deep Florence soil is on the round tops and sides of ridges. The moderately deep Labette soil is in gently sloping areas on ridgetops. Scattered coarse cherty fragments are on the surface in most areas. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 60 percent Florence soil and 25 percent Labette soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Florence soil has a surface layer of very dark brown cherty silt loam about 13 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, friable very cherty silty clay loam; the next part is reddish brown and yellowish red, extremely firm very cherty clay; and the lower part is reddish brown, mottled, very firm cherty clay. Cherty limestone is at a depth of about 45 inches. In some areas the silty surface soil is much thicker.

Typically, the Labette soil has a surface layer of very dark brown silty clay loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone is at a depth of about 31 inches. In some areas the soil is grayer and is more than 40 inches deep over bedrock.

Included with these soils in mapping are small areas of Clime and Dwight soils, which make up 15 percent of the unit. The calcareous Clime soils are 20 to 40 inches deep over shale. They are on side slopes. Dwight soils are sodium affected and are 40 to 60 inches deep over hard limestone or shale. They are on ridgetops.

Permeability is moderately slow in the Florence soil and slow in the Labette soil. Available water capacity is low in both soils. Surface runoff is rapid on the Florence soil and medium on the Labette soil. The shrink-swell potential is moderate in the subsoil of the Florence soil and high in the subsoil of the Labette soil. Root penetration is restricted by the limestone at a depth of about 31 inches in the Labette soil.

Most areas are used as range. A few of the less cherty areas on foot slopes are abandoned cropland. Because the chert fragments interfere with tillage and because erosion is a severe hazard, these soils generally are unsuited to cultivated crops. They are best suited to range. The native vegetation dominantly is big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

These soils are moderately well suited to dwellings. The shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements, and the content of cherty fragments in the Florence soil is a limitation on sites for dwellings without basements. The cherty fragments may interfere with cutting and filling when the dwellings are built. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. The deep included soils generally can be used as sites for dwellings with basements.

These soils are only moderately well suited to local roads and streets because of the shrink-swell potential and low strength. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soils. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Mainly because of the depth to bedrock and the slow or moderately slow permeability, these soils generally are unsuitable as septic tank absorption fields. They are poorly suited to sewage lagoons because of the slope of the Florence soil and the depth to bedrock in the Labette soil. Suitable sites for lagoons commonly are available in areas on the lower side slopes adjacent to the Florence soil. Some land shaping generally is needed.

The capability subclass is VIe.

Ic—Ivan silt loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains cut by meandering stream channels (fig. 8). It generally is flooded several times each year. Individual areas are long and narrow or irregular in shape. They are 250 to 800 feet wide.

Typically, the surface soil is black, calcareous silt loam about 14 inches thick. The next 13 inches is very dark gray, calcareous, friable silt loam. The substratum to a depth of about 60 inches is dark brown, calcareous silt loam. In some areas the soil is noncalcareous. In other areas the surface layer has thin grayish brown strata.

Included with this soil in mapping are small areas of Chase, Osage, Martin, and Dennis soils. These soils make up 10 to 15 percent of the unit. They are noncalcareous. Their subsoil contains more clay than that of the Ivan soil. Chase and Osage soils are in swales. Martin and Dennis soils are on foot slopes.

Permeability is moderate in the Ivan soil, and available water capacity is very high. Surface runoff is slow. The shrink-swell potential is moderate.

Most areas are used as range, but a few are used as tame grass pasture or as woodland. This soil generally is unsuited to cultivated crops because the flooding is a hazard and because operating farm machinery is difficult

Figure 8.—A meandering stream in an area of Ivan silt loam, channeled.

along the meandering stream channels. In many areas, the range is overgrazed and in poor condition and the more desirable grasses have been replaced by less productive grasses and weeds. The cattle tend to congregate around the watering facilities and shade trees near these areas. Rotation grazing and restricting grazing to winter increase forage production.

A few areas support native hardwoods. This soil is well suited to trees. Flooding and plant competition are management concerns. Tree seeds, cuttings, and seedlings grow well only if competing vegetation is controlled or removed. Proper site preparation, controlled burning or spraying, cutting, and girdling help to control the undesirable plants. Important commercial species include black walnut, pecan, bur oak, hackberry, eastern cottonwood, and green ash.

The vegetation commonly growing on this soil provides habitat for many kinds of wildlife, including quail, deer, wild turkey, rabbits, and numerous songbirds. The wildlife population can be increased by increasing the number of fringe areas where woodland is adjacent to cropland.

This soil generally is unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood control measures.

The capability subclass is Vw.

If—Ivan silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 7 inches thick. The subsurface layer is very dark grayish brown, calcareous silt loam about 9 inches thick. The next 22 inches is very dark grayish brown, friable, calcareous silt loam. The substratum to a depth of about 60 inches is dark brown, calcareous silt loam. In some areas the soil is noncalcareous.

Included with this soil in mapping are small areas of the somewhat poorly drained Chase soils in swales.

These soils make up 5 to 10 percent of the unit. Their subsoil contains more clay than that of the Ivan soil.

Permeability is moderate in the Ivan soil, and available water capacity is very high. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate.

Most areas are used for cultivated crops. The rest are used as tame grass pasture or as woodland. This soil is well suited to corn, sorghum, soybeans, wheat, and alfalfa. The flooding is a hazard. It delays spring planting in some years. Building terraces and minimizing tillage on the adjacent uplands help to keep floodwater away from this soil. Crop rotations help to control weeds, plant diseases, and insect carryover.

This soil is well suited to tame grass for grazing or hay. Grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, restricted use during wet periods, and timely deferment of grazing help to keep the grass cover and the soil in good condition. Applications of fertilizer generally are needed.

This soil is well suited to trees. Flooding and plant competition are management concerns. Tree cuttings and seedlings grow well only if competing vegetation is controlled. Proper site preparation, controlled burning or spraying, cutting, and girdling help to control the undesirable plants. Important commercial species include black walnut, pecan, bur oak, hackberry, eastern cottonwood, and green ash.

The areas where cropland is adjacent to grassland or woodland provide habitat for many kinds of wildlife, including deer, quail, wild turkey, and numerous songbirds. Good woodland management increases the wildlife population.

This soil generally is unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood control measures.

The capability subclass is IIw.

Ka—Kenoma silt loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on the broad tops of upland ridges and on high terraces. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is mottled, very firm silty clay about 22 inches thick. The upper part is very dark brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm silty clay loam. The surface layer is silty clay loam or silty clay in areas where it has been mixed with the upper part of the subsoil by plowing. In some areas the upper part of the subsoil is friable silty clay loam. In other areas the depth to bedrock is less than 40 inches.

Permeability is very slow, and available water capacity is high. Surface runoff is slow. The shrink-swell potential is high in the subsoil. Tilth is good.

Most areas are used as range or hayland or have been reseeded to tame grasses, but some are used for cultivated crops. This soil is suited to wheat, grain sorghum, alfalfa, and soybeans. Erosion is a hazard, however, if cultivated crops are grown. Also, productivity is reduced during periods of drought because the clayey subsoil does not readily release moisture to plants. Contour farming, terraces, grassed waterways, and minimum tillage help to prevent excessive soil loss. Returning crop residue to the soil helps to prevent deterioration of tilth, conserves moisture, and increases the infiltration rate (fig. 9).

This soil is suited to range. The native vegetation dominantly is big bluestem, little bluestem, indiangrass, and switchgrass. In severely overgrazed areas these productive grasses are replaced by less desirable plants, such as tall dropseed, buffalograss, annual broomweed, and western ragweed. Proper stocking rates and rotation grazing help to keep the range in good condition. Early mowing of hay allows the plants to recover before the first frost.

The areas of pasture grasses, mainly cool season grasses, are used for grazing and hay. Controlled grazing and timely mowing help to keep the pasture in good condition. Applications of fertilizer increase plant vigor.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the very slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping may be needed.

The capability subclass is IIIe.

Ke—Kenoma silty clay loam, 2 to 5 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on the tops and upper sides of upland ridges. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 4 inches thick. The subsoil is mottled silty clay about 32 inches thick. The upper part is very dark brown and very firm, the next part is brown and extremely firm, and the lower part is dark yellowish brown and extremely firm. The substratum to a depth of about 60 inches is grayish brown and brown, mottled,

Figure 9.—A good cover of crop residue in an area of Kenoma silt loam, 1 to 4 percent slopes.

very firm silty clay. In some areas the surface layer is thicker and is silt loam. In other areas it is silty clay. In places the subsoil is grayer.

Permeability is very slow, and available water capacity is moderate. Surface runoff is medium. The shrink-swell potential is high in the subsoil. The surface layer is firm and has a moderately low content of organic matter. As a result, it cannot be tilled easily, crusts readily, and takes in water slowly.

Almost all areas formerly were used for cultivated crops, but most are now pasture, range, or abandoned cropland. Wheat, grain sorghum, and soybeans are the main crops in the few areas that are still cultivated. This soil is moderately well suited to cultivated crops. Further erosion is the main hazard. Also, the soil is droughty in summer because the clayey subsoil absorbs and releases moisture slowly. Terraces, contour farming, grassed waterways, and minimum tillage help to control runoff and erosion. Leaving crop residue on the surface and applying barnyard manure increase the infiltration rate and improve tilth.

This soil is best suited to tame grass pasture or range. A cover of grasses is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment of grazing, brush control, and restricted use during wet periods help to keep the pasture or range in good condition. Range seeding is needed to restore the productivity of abandoned cropland. Applications of fertilizer increase forage production in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained

base material helps to prevent the road damage caused by shrinking and swelling.

Because of the very slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping may be needed.

The capability subclass is IVe.

La—Labette silty clay loam, 1 to 4 percent slopes. This moderately deep, gently sloping, well drained soil is on the tops and upper sides of upland ridges. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, mottled, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone is at a depth of about 31 inches. In some areas, the depth to bedrock is more than 40 inches and the subsoil is grayer.

Included with this soil in mapping are small areas of Sogn soils, which make up 5 to 10 percent of the unit. These soils are less than 20 inches deep over limestone. They are near areas where rock crops out.

Permeability is slow in the Labette soil, and available water capacity is moderate. Surface runoff is medium. The shrink-swell potential is high in the subsoil. Tilth is good. Root penetration is restricted by the limestone at a depth of about 31 inches.

About half the acreage is used for cultivated crops, and the rest is used as range. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Erosion is a hazard if cultivated crops are grown. It can be controlled, however, by minimum tillage, terraces, grassed waterways, and contour farming. Returning crop residue to the soil improves fertility and helps to prevent deterioration of tilth.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates and rotation grazing help to keep the range in good condition. Invasion of brushy plants, such as osageorange and eastern redcedar, is a problem in some areas. Timely burning helps to control these plants. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. The areas where the depth to bedrock is more than 40 inches generally can be used as sites for dwellings with basements.

Because of low strength and the shrink-swell potential, this soil is only moderately well suited to local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Mainly because of the depth to bedrock, this soil generally is unsuitable as a septic tank absorption field and is poorly suited to sewage lagoons. The areas where the depth to bedrock is more than 40 inches generally can be used as sites for lagoons.

The capability subclass is IIe.

Ld—Labette-Dwight complex, 0 to 3 percent slopes. These nearly level soils are on the tops of upland ridges. The Labette soil is moderately deep and well drained, and the Dwight soil is deep and moderately well drained. Individual areas are irregular in shape and range from 10 to 500 acres in size. They are about 50 to 75 percent Labette soil and 20 to 40 percent Dwight soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Labette soil has a very dark brown silty clay loam surface layer about 9 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, firm silty clay loam; the next part is dark brown, very firm silty clay; and the lower part is dark brown, extremely firm silty clay. Hard limestone is at a depth of about 36 inches.

Typically, the Dwight soil has a black silt loam surface layer about 4 inches thick. The subsoil is extremely firm clay about 30 inches thick. The upper part is black, the next part is very dark grayish brown, and the lower part is dark brown. The substratum is reddish brown silty clay. Hard limestone is at a depth of about 44 inches.

Included with these soils in mapping are small areas of the deep, somewhat poorly drained Zaar soils. These included soils make up 5 to 10 percent of the unit. They have a silty clay surface layer.

Permeability is slow in the Labette soil and very slow in the Dwight soil. The Dwight soil does not absorb moisture easily or release it readily to plants. Available water capacity is moderate in the Labette soil and low in the Dwight soil. Surface runoff is medium on both soils. The shrink-swell potential is high in the subsoil. The content of sodium in the subsoil of the Dwight soil adversely affects the growth of most plants. Root penetration is restricted by the limestone at a depth of about 36 inches in the Labette soil.

Most areas are used as range, but a few are cultivated. Because of a hazard of erosion and the low or moderate available water capacity, these soils are poorly suited to cultivated crops. They are best suited to

range or pasture. The dominant native vegetation on the Labette soil is big bluestem, little bluestem, and indiangrass. That on the Dwight soil includes tall, mid, and short grasses. It does not grow so well as that on the Labette soil. In overgrazed areas the range is invaded by short grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland. Timely grazing and haying and applications of fertilizer are beneficial if the soils are used as tame grass pasture.

The diverse vegetation common on these soils provides good habitat for prairie chickens. The areas of short grasses on the Dwight soil are used as booming ground. Good range management provides nesting areas for the prairie chickens by maintaining a good stand of tall native grasses.

These soils are moderately well suited to dwellings. The shrink-swell potential is a limitation. Also, the depth to bedrock in the Labette soil is a limitation on sites for dwellings with basements. As a result, the deep Dwight soil is a better site. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

Because of low strength and the shrink-swell potential, these soils are only moderately well suited to local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soils. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow or very slow permeability and the depth to bedrock, these soils generally are unsuitable as septic tank absorption fields. The deep Dwight soil is better suited to sewage lagoons than the moderately deep Labette soil.

The capability subclass is IIIe.

Ls—Labette-Sogn silty clay loams, 0 to 8 percent slopes. These nearly level to moderately sloping soils are on the tops and sides of upland ridges. The Labette soil is moderately deep and well drained. The Sogn soil is shallow and somewhat excessively drained. It is near areas where rock crops out. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 30 to 70 percent Labette soil and 25 to 50 percent Sogn soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Labette soil has a dark brown silty clay loam surface layer about 9 inches thick. The subsoil is about 17 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is reddish brown, very firm silty clay. Hard limestone is at a depth of about 26 inches.

Typically, the Sogn soil has a very dark brown silty clay loam surface layer about 7 inches thick. The subsurface layer is dark brown silty clay loam about 8 inches thick. Hard limestone is at a depth of about 15 inches.

Included with these soils in mapping are small areas of Clime soils and small areas where limestone crops out. The calcareous Clime soils are underlain by clayey shale. They are below the areas where limestone crops out. Included areas make up 5 to 10 percent of the unit.

Permeability is slow in the Labette soil and moderate in the Sogn soil. Available water capacity is low in the Labette soil and very low in the Sogn soil. Surface runoff is rapid on both soils. The shrink-swell potential is high in the subsoil of the Labette soil and moderate in the Sogn soil. Root penetration is restricted by the limestone at a depth of about 26 inches in the Labette soil and about 15 inches in the Sogn soil.

Nearly all of the acreage is used as range. Mainly because erosion is a severe hazard but also because rockiness interferes with tillage, these soils generally are unsuited to cultivated crops. They are best suited to range. The dominant native vegetation is big bluestem, little bluestem, indiangrass, and, on the Sogn soil, sideoats grama. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and rotation grazing help to keep the range in good condition. Brushy plants, such as osageorange and sumac, invade in some areas. Brush control is needed in these areas. Spring burning helps to control woody plants. The number of suitable pond sites is limited because of the shallowness to bedrock.

The Labette soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the depth to bedrock, the Labette soil generally is unsuitable as a septic tank absorption field and is poorly suited to sewage lagoons. The deeper soils on adjacent foot slopes are suitable sites for lagoons.

The Sogn soil generally is unsuitable for building site development because it is shallow over bedrock.

The capability subclass is VIe.

Ma—Martin silty clay loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on side slopes and foot slopes along drainageways. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is black silty clay loam about 12 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is black, firm silty clay loam; the next part is very dark gray and dark gray, mottled, very firm silty clay; and the lower part is grayish brown, mottled, extremely firm silty clay. In a few small eroded areas, the surface layer is silty clay. In some areas the depth to shale is less than 40 inches.

Permeability is slow, and available water capacity is high. Surface runoff is medium. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. Tilth is good. The shrink-swell potential is high in the subsoil.

About half the acreage is used for cultivated crops, and half is used as range or pasture. This soil is well suited to sorghum, soybeans, wheat, and alfalfa. Erosion is a hazard if cultivated crops are grown. It can be controlled, however, by minimum tillage, contour farming, terraces, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to prevent deterioration of tilth and fertility.

This soil is suited to range. The dominant native grasses are big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, and restricted use during prolonged wet periods help to keep the range in good condition. Early mowing of hay allows the plants to recover before the first frost. Timely grazing and applications of fertilizer are beneficial in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by wetness and by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping may be needed.

The capability subclass is IIe.

Mb—Martin silty clay loam, 4 to 7 percent slopes. This deep, moderately sloping, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 400 acres in size.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsoil is silty clay about 41 inches thick. The upper part is black and very firm, and the lower part is very dark gray and dark gray, mottled, and extremely firm. The substratum to a depth of about 60 inches is dark brown clay. In a few small eroded areas, the surface layer is silty clay. In some areas the depth to shale is less than 40 inches.

Included with this soil in mapping are small areas of the calcareous Clime soils on the upper side slopes. These soils make up 5 to 10 percent of the unit.

Permeability is slow in the Martin soil, and available water capacity is moderate. Surface runoff is medium. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. Tilth is good. The shrink-swell potential is high in the subsoil.

Most areas are used as range or pasture. The rest are used for cultivated crops. This soil is moderately well suited to wheat, soybeans, and sorghum. If cultivated crops are grown, erosion is a hazard. It can be controlled, however, by minimum tillage, terraces, grassed waterways, and contour farming. Returning crop residue to the soil or adding other organic material helps to prevent deterioration of tilth and fertility.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, and indiangrass. In overused areas the less productive grasses, such as tall dropseed, sideoats grama, and buffalograss, make up a larger part of the plant community. Proper stocking rates, a uniform distribution of grazing, and timely deferment of haying or grazing help to keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Applications of fertilizer increase forage production in the areas of tame grasses.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by wetness and by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping may be needed.

The capability subclass is IIIe.

Me—Martin silty clay, 3 to 7 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on upland side slopes and foot slopes, some of which are dissected by many gullies. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is very dark brown silty clay about 7 inches thick. The subsoil is silty clay about 25 inches thick. The upper part is very dark gray and very firm, and the lower part is dark yellowish brown, mottled, and extremely firm. The substratum is dark brown silty clay. Shale is at a depth of about 52 inches. In some areas the surface layer is silty clay loam and is thicker and more friable. In other areas the depth to shale is less than 40 inches.

Included with this soil in mapping are small areas of the calcareous Clime soils on the upper side slopes. These soils make up 5 to 10 percent of the unit.

Permeability is slow in the Martin soil, and available water capacity is moderate. Surface runoff is rapid. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring. The shrink-swell potential is high in the subsoil. Tilth is poor. The content of organic matter is moderately low.

Nearly all areas formerly were cultivated, but only about half are still used for cultivated crops, mainly wheat, soybeans, and sorghum. Some areas have been reseeded to grass or are abandoned cropland. This soil is poorly suited to cultivated crops. Further erosion is the main hazard. Also, the soil is droughty in the summer because it absorbs and releases moisture slowly. Terraces, contour farming, grassed waterways, and minimum tillage help to control runoff and erosion. Leaving crop residue on the surface and applying barnyard manure increase the infiltration rate and improve tilth.

This soil is best suited to tame grass pasture and to range. A cover of grasses is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, timely deferment of grazing, brush control, and restricted use during wet periods help to keep the pasture or range in good condition. Range seeding is needed to restore the productivity of abandoned cropland. In some areas land smoothing is needed before the grasses are seeded. Applications of fertilizer increase forage production in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by wetness and by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is well suited to sewage lagoons. Because of the slope, however, some land shaping may be needed.

The capability subclass is IVe.

Na—Newtonia silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on old high terraces and on the tops of upland ridges. Individual areas are irregular in shape and range from 10 to 75 acres in size.

Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsurface layer is dark brown silt loam about 4 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark reddish brown, firm silty clay loam; the next part is dark red and reddish brown, mottled, firm and very firm silty clay loam; and the lower part is yellowish red, very firm silty clay. In some areas the subsoil is grayish brown.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The shrink-swell potential is moderate in the subsoil. Tilth is good.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, corn, sorghum, soybeans, and alfalfa. Leaving crop residue on the surface and minimizing tillage help to prevent deterioration of tilth and fertility and a decrease in the content of organic matter. Crop rotations help to control weeds, plant diseases, and insect carryover.

This soil is well suited to dwellings and moderately well suited to local roads and streets. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material, however, help to prevent the structural damage cause by shrinking and swelling. Low strength is a limitation on sites for local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Also, providing coarser grained base material helps to ensure better performance.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field, however, helps to overcome this limitation. Seepage is a limitation on

sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability class is I.

Nd—Niotaze-Darnell complex, 0 to 6 percent slopes. These nearly level to moderately sloping soils are on the tops and sides of upland ridges. The Niotaze soil is moderately deep and somewhat poorly drained, and the Darnell soil is shallow and well drained. Individual areas are irregular in shape and range from 20 to 200 acres in size. They are about 65 percent Niotaze soil and 30 percent Darnell soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Niotaze soil has a dark brown loam surface layer about 3 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown and very firm. The upper part is clay, and the lower part is mottled silty clay. Clayey shale is at a depth of about 27 inches. In some areas the subsoil is clay loam. In a few areas the depth to bedrock is more than 40 inches.

Typically, the Darnell soil has a very dark grayish brown fine sandy loam surface layer about 6 inches thick. The subsoil is brown, very friable fine sandy loam about 10 inches thick. Reddish sandstone is at a depth of about 16 inches.

Included with these soils in mapping are areas where sandstone crops out. These included areas commonly are on the lower parts of the landscape. They make up about 5 percent of the unit.

Permeability is slow in the Niotaze soil and moderately rapid in the Darnell soil. Available water capacity is low in the Niotaze soil and very low in the Darnell soil. Surface runoff is medium on both soils. The Niotaze soil has a perched seasonal high water table at a depth of 1 to 2 feet in winter and spring. The shrink-swell potential is high in the subsoil of the Niotaze soil. Root penetration is restricted by the clayey shale at a depth of about 27 inches in the Niotaze soil and by the sandstone at a depth of about 16 inches in the Darnell soil.

Most of the acreage is woodland that has an understory of shrubs and grasses. A few of the less rocky areas formerly were cultivated but are now abandoned cropland. Because erosion is a severe hazard and because the rockiness interferes with tillage, these soils generally are unsuited to cultivated crops. They generally are not productive as woodland, but some trees are harvested for firewood.

These soils are best suited to native range and tame grass pasture. The dominant vegetation is post oak and blackjack oak and an understory of big bluestem, little bluestem, and other grasses. If the range or pasture is overgrazed, the more desirable grasses are replaced by less productive mid and short grasses and by weeds and brush. Forage production is reduced if the scrub oak canopy becomes too thick. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, and timely burning help to keep the range in good condition. The trees can also be controlled by spraying or clearing. Forage production is low on abandoned cropland. It can be increased by seeding mid and tall grasses.

The diverse vegetation of trees, shrubs, and grasses provides good habitat for many wildlife species, including deer, quail, wild turkey, and numerous songbirds. Brush control increases the wildlife population.

These soils are moderately well suited to dwellings and local roads and streets. The depth to bedrock in the Darnell soil is a limitation, but in some areas the rock can be easily dug by power equipment. The wetness and shrink-swell potential of the Niotaze soil are limitations on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material, however, help to prevent the structural damage caused by wetness and by shrinking and swelling. Low strength and the shrink-swell potential are limitations if the Niotaze soil is used as a site for local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the depth to bedrock, the Darnell soil generally is unsuitable as a site for septic tank absorption fields and sewage lagoons. Because of the slow permeability and the depth to bedrock, the Niotaze soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the wetness and the depth to bedrock. The few areas where the depth to bedrock is more than 40 inches are better sites for lagoons. Some land shaping may be needed in these areas.

The capability subclass is VIe.

Nz—Niotaze-Darnell complex, 6 to 35 percent slopes. These moderately sloping to steep soils are on the tops and sides of upland ridges. The Niotaze soil is moderately deep and somewhat poorly drained. The Darnell soil is shallow and well drained. It generally is on the less sloping ridges. In some areas stones and boulders are on the surface. Individual areas are irregular in shape and range from 10 to several hundred acres in size. They are about 75 percent Niotaze soil and 15 percent Darnell soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Niotaze soil has a dark brown loam surface layer about 3 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown and very firm. The upper part is clay, and the lower part is mottled silty

clay. Clayey shale is at a depth of about 27 inches. In some areas the subsoil is clay loam.

Typically, the Darnell soil has a very dark grayish brown fine sandy loam surface layer about 6 inches thick. The subsoil is brown, very friable fine sandy loam about 10 inches thick. Reddish sandstone is at a depth of about 16 inches.

Included with these soils in mapping are areas of short, steep escarpments and areas where sandstone crops out. These included areas make up about 10 percent of the unit.

Permeability is slow in the Niotaze soil and moderately rapid in the Darnell soil. Available water capacity is low in the Niotaze soil and very low in the Darnell soil. Surface runoff is rapid on both soils. The Niotaze soil has a perched seasonal high water table at a depth of 1 to 2 feet in winter and spring. The shrink-swell potential is high in the subsoil of the Niotaze soil. Root penetration is restricted by the clayey shale at a depth of about 27 inches in the Niotaze soil and by the sandstone at a depth of about 16 inches in the Darnell soil.

These soils are used as range. They are best suited to native grasses. In nearly all areas the overstory is blackjack oak and post oak. The understory is mainly little bluestem and big bluestem. The major concerns of management are undesirable plants and erosion. A good plant cover and ground mulch help to prevent excessive soil loss, reduce the runoff rate, and conserve moisture. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by the less productive grasses and by weeds and scrub oak. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition. The trees can be controlled by spraying or clearing.

These soils generally are not productive as woodland. Some trees, however, are cut for firewood.

If managed properly, these soils provide habitat for many wildlife species, including deer, wild turkey, quail, and many nongame birds. Proper grazing use, brush control, and establishment of feed areas increase the wildlife population.

These soils are poorly suited to dwellings. The main limitations are the slope of both soils, the wetness and high shrink-swell potential in the Niotaze soil, and the depth to bedrock in the Darnell soil. The less sloping parts of the unit should be selected as sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by wetness and by shrinking and swelling. The deeper soils in the unit should be selected as sites for dwellings with basements.

These soils are poorly suited to local roads and streets. The main limitations are the slope of both soils and the low strength and shrink-swell potential of the Niotaze soil. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the Niotaze soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling. Building the roads on the contour and establishing vegetation as soon as possible on road cuts help to prevent excessive soil loss.

Mainly because of the slope and the depth to bedrock, these soils generally are unsuitable as sites for sewage disposal systems. Some of the adjacent areas on foot slopes are suitable sites for sewage lagoons.

The capability subclass is VIe.

Od—Oil wasteland. This map unit occurs as moderately deep and deep, nearly level to moderately sloping areas on the tops and sides of ridges (fig. 10). It is in areas near oil wells and storage tanks where waste oil and saltwater have been dumped. Individual areas are irregular in shape and are 5 to 20 acres in size.

The original soil cannot be identified in most areas. It generally is clayey. It has been saturated with oil waste and saltwater. The salts generally are more concentrated near the surface. The clayey material has been damaged so extensively that it takes in water very slowly. Surface runoff is rapid, and the hazard of erosion is severe. The areas generally are severely eroded. They support very little vegetation.

Included with the wasteland in mapping are some areas of Clime, Martin, and other soils. These soils are sparsely vegetated.

This unit generally is unsuited to cultivated crops and to grasses because of the high content of salts. Some reclamation is possible, but it generally is impractical. Diverting the runoff from the higher lying adjacent areas helps to control erosion.

No capability class or subclass is assigned to this unit.

Op—Olpe gravelly silt loam, 4 to 15 percent slopes. This deep, well drained, moderately sloping and strongly sloping soil is on the tops and sides of ridges in the uplands. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is dark brown gravelly silt loam about 13 inches thick (fig. 11). The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, firm very gravelly silty clay loam; the next part is reddish brown, very firm very gravelly silty clay; and the lower part is dark red, very firm gravelly and very gravelly clay.

Included with this soil in mapping are small areas of Kenoma and Labette soils, which make up 5 to 15 percent of the unit. These soils are on the less sloping ridgetops above the Olpe soil. Their content of cherty gravel is less than 35 percent.

Figure 10.—An area of Oil wasteland, which supports very little vegetation.

Permeability is slow in the Olpe soil, and available water capacity is low. Surface runoff is medium. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used as range. Because erosion is a severe hazard and the surface gravel interferes with tillage, this soil generally is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as buffalograss and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition. Many areas are potential sites for ponds.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential and the slope are limitations. The less sloping areas should be selected as sites for these uses. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields because of the slow permeability. Enlarging the

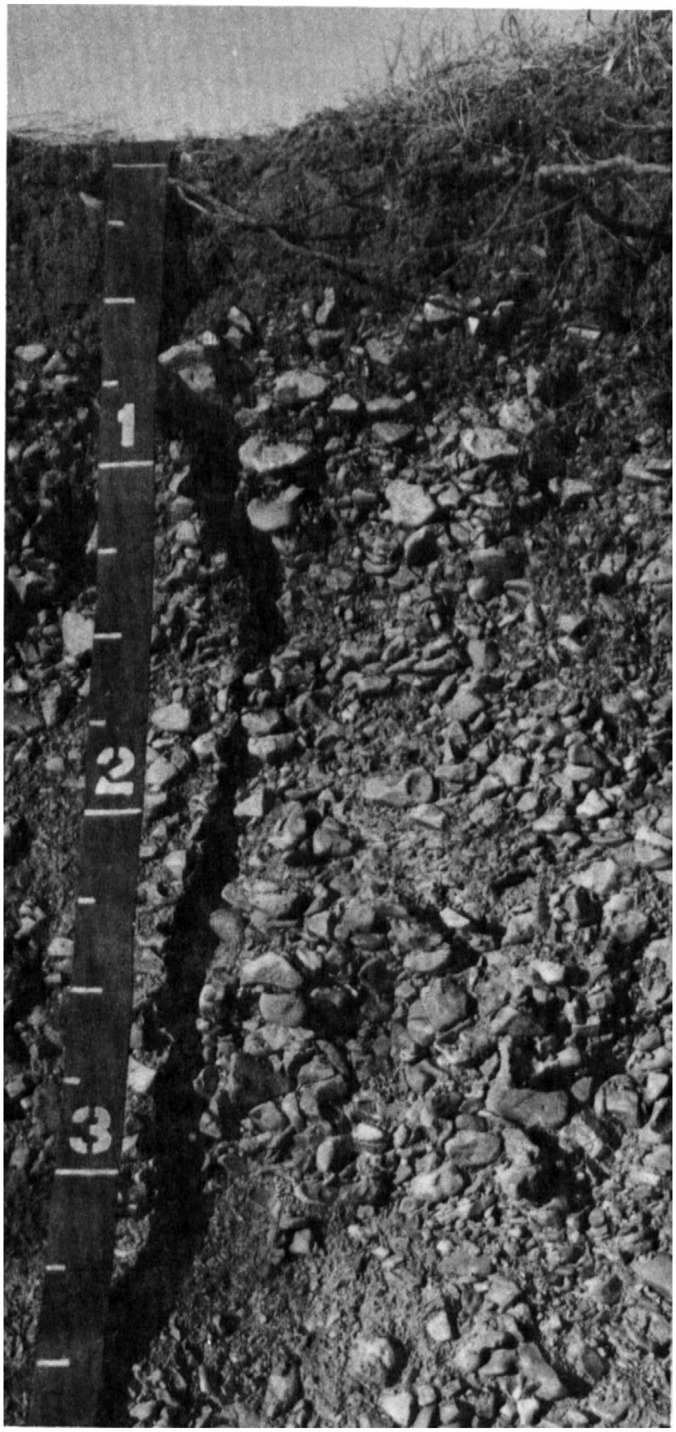

Figure 11.—Profile of Olpe gravelly silt loam, 4 to 15 percent slopes. The pebbles are rounded chert fragments. Depth is marked in feet.

absorption field, however, helps to overcome this limitation. The soil is moderately well suited to sewage lagoons. The slope is a limitation. Some land shaping may be needed to keep surface water away from the lagoon.

The capability subclass is VIe.

Os—Osage silty clay. This deep, nearly level, poorly drained soil is on flood plains. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer is black, very firm silty clay about 6 inches thick. The subsoil is extremely firm silty clay about 39 inches thick. The upper part is very dark gray, and the lower part is very dark grayish brown and very dark gray and is mottled. The substratum to a depth of about 60 inches is dark grayish brown, mottled silty clay. In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of the well drained Ivan soils, which make up less than 5 percent of the unit. These soils are closer to stream channels than the Osage soil.

Permeability is very slow in the Osage soil, and available water capacity is moderate. Surface runoff is very slow. A seasonal high water table is within a depth of 1 foot in winter and spring. The shrink-swell potential is very high in the subsoil. The surface layer is very firm and cannot be easily tilled.

Most of the acreage is used for cultivated crops, but a small acreage is used as tame grass pasture. This soil is suited to grain sorghum, soybeans, and wheat. The wetness and the flooding, however, can delay fieldwork and damage crops. Field drainage ditches, a surface bedding system, and land leveling help to remove excess surface water. Tilling in the fall results in a better seedbed the following spring. Freezing and thawing in winter are beneficial because they result in a loose granular structure to a depth of 3 or 4 inches. Returning crop residue to the soil improves tilth and increases the infiltration rate. Crop rotations help to control weeds, plant disease, and insect carryover.

This soil is well suited to tame grass pasture and hay. Overgrazing and haying or grazing during wet periods, however, cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Applications of fertilizer improve forage production.

A few areas support native hardwoods. This soil is moderately well suited to trees. The equipment limitation is moderate, and seedling mortality and plant competition are severe. Harvesting equipment can be used only during dry periods. Tree cuttings and seedlings grow well only if competing plants are controlled or removed. Proper site preparation, controlled burning or spraying, cutting, and girdling help to control the undesirable plants.

This soil generally is unsuitable as a site for dwellings and sanitary facilities because of the flooding.

Overcoming this hazard is difficult without major flood control measures.

The capability subclass is IIw.

Pt—Pits, quarries. This map unit occurs as areas from which soil and some underlying limestone and shale have been removed. The underlying material has been quarried for use as gravel and for use in the manufacturing of cement, brick, and agricultural lime. Individual areas are irregular in shape and range from 10 to 100 acres in size.

A typical quarry is a pit surrounded by vertical walls 8 to 20 feet high. Small piles of rock, shale, and gravel are around the outer edge of some quarries.

This unit is unsuitable for cultivation and for most other uses. The surface generally is bare. Scattered trees, shrubs, and clumps of grass border the quarries.

No capability class or subclass is assigned to this unit.

Re—Reading silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is very dark brown, friable silt loam about 5 inches thick. The subsoil is firm silty clay loam about 31 inches thick. The upper part is very dark grayish brown, and the lower part is dark brown. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silty clay loam. In some areas, the subsoil is silt loam and the soil is calcareous throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Chase soils on the slightly lower stream terraces. Also included are steeper slopes along the terrace breaks. Included areas make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Reading soil, and available water capacity is very high. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops, but a few are used for tame grass pasture or hay. This soil is well suited to corn, sorghum, soybeans, wheat, and alfalfa. Minimizing tillage and leaving crop residue on the surface help to prevent deterioration of tilth and fertility. They also help to prevent the excessive soil loss caused by scouring during periods of flooding. Crop rotations help to control weeds, plant diseases, and insect carryover.

This soil is suited to tame grasses for hay or pasture. Proper stocking rates, pasture rotation, timely deferment of haying or grazing, and restricted use during wet periods help to keep the pasture or hayland in good condition. Applications of fertilizer increase forage production.

This soil is suited to the trees grown as environmental or commercial plantings. Plant competition is moderate. Tree cuttings and seedlings survive and grow well only if the competing plants are controlled or removed by proper site preparation or by spraying, cutting, or girdling. Important commercial species include black walnut, hackberry, bur oak, pecan, and green ash.

This soil is poorly suited to dwellings and moderately well suited to local roads and streets. The flooding is a hazard on sites for dwellings. As a result, the highest areas on the landscape should be selected as building sites. Levees and dikes help to control the floodwater. Low strength is a limitation on sites for local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field, however, helps to overcome this limitation. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon with soil material that is more slowly permeable.

The capability class is I.

St—Steedman stony loam, 3 to 12 percent slopes. This moderately deep, moderately well drained, gently sloping to strongly sloping soil is on uplands. Many sandstone fragments are on the surface (fig. 12). They are 1 to 2 feet in diameter and 10 to 30 feet apart. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown stony loam about 8 inches thick. The subsoil is mottled, very firm silty clay about 22 inches thick. The upper part is reddish brown, and the lower part is dark yellowish brown. Clayey shale is at a depth of about 30 inches. In some areas the surface layer is silt loam or silty clay loam and is more than 10 inches thick. In other areas the depth to shale is more than 40 inches.

Included with this soil in mapping are narrow bands where fractured sandstone crops out. The rocks in these areas are as much as 4 feet in diameter and cover about 15 percent of the surface. Also included are small areas of soils that are moderately deep over sandstone and have a loamy subsoil. These soils generally are near the areas where sandstone crops out. Included areas make up 5 to 10 percent of the unit.

Permeability is slow in the Steedman soil, and available water capacity is low. Surface runoff is rapid. A perched seasonal high water table is at a depth of 0.5 to 1.0 foot in winter and early in spring. The shrink-swell potential is high in the subsoil. Root penetration is restricted by the clayey shale at a depth of about 30 inches.

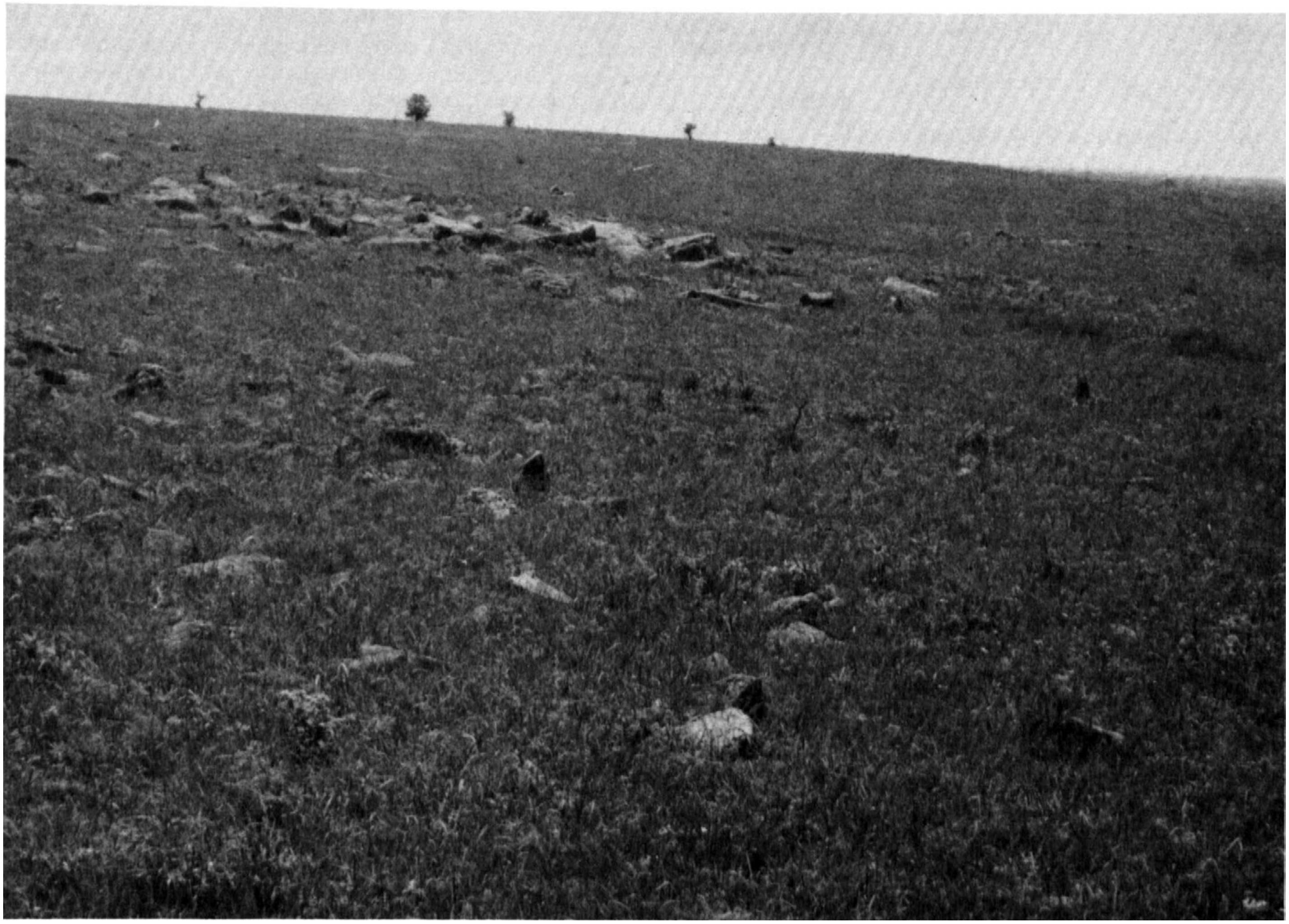

Figure 12.—Sandstone fragments on the surface of Steedman stony loam, 3 to 12 percent slopes.

Nearly all areas are used as range. Because the hazard of erosion is severe and the surface stones interfere with tillage, this soil generally is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is big bluestem, little bluestem, indiangrass, and switchgrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses, by weeds, and by brushy species, such as blackberry vines and sumac. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good conditon. In some areas brush control is needed to improve the range condition. Many areas are potential sites for ponds.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings, and low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling and by wetness. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the depth to bedrock and the slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage

lagoons because of the depth to bedrock, the slope, and the wetness. The areas where the depth to bedrock is more than 40 inches are better sites for lagoons. Some land shaping generally is needed.

The capability subclass is VIe.

Wo—Woodson silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad upland flats. Individual areas are irregular in shape and range from 20 to more than 1,000 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. The subsoil is about 33 inches thick. The upper part is black, very firm silty clay; the next part is very dark gray, mottled, extremely firm clay; and the lower part is dark grayish brown, mottled, extremely firm clay. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam. In some areas the subsoil is dark brown. In other areas the surface layer is silty clay.

Permeability is very slow, and available water capacity is high. Surface runoff is slow. A perched seasonal high water table is at a depth of 0.5 to 2.0 feet in winter and early in spring. The shrink-swell potential is high in the subsoil. Tilth is good.

About half of the acreage is used for cultivated crops or for tame grasses, and half is used as native range. This soil is well suited to wheat, alfalfa, soybeans, and sorghum. Because the clayey subsoil does not readily release moisture to plants, however, productivity is reduced during periods of drought. Also, the wetness commonly delays tillage in the spring. As a result, a surface drainage system is needed in some areas. Returning crop residue to the soil helps to prevent deterioration of tilth and fertility and conserves moisture.

This soil is suited to tame or native grasses for hay or pasture. The main management needs in the areas of grassland are measures that maintain a good plant cover. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as annual broomweed, tall dropseed, and buffalograss. Overgrazing or grazing during prolonged wet periods causes excessive surface compaction and reduces the rate of water infiltration. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, restricted use during wet periods, and rotation grazing help to keep the grassland in good condition. Applications of fertilizer increase forage production in the areas of tame grasses.

This soil is moderately well suited to dwellings. The wetness and the shrink-swell potential are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by wetness and by shrinking and swelling.

Because of low strength, the wetness, and the shrink-swell potential, this soil is only moderately well suited to local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling. Building the roads on raised fill material, establishing adequate side ditches, and installing culverts reduce the wetness.

This soil is well suited to sewage lagoons. Because of the very slow permeability, however, it generally is unsuitable as a septic tank absorption field.

The capability subclass is IIs.

Za—Zaar silty clay, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on upland foot slopes and old high terraces. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is black silty clay about 7 inches thick. The subsurface layer is black, very firm silty clay about 6 inches thick. The subsoil is mottled silty clay about 40 inches thick. The upper part is black and very dark gray and is extremely firm, and the lower part is dark brown, brown, and dark gray and is extremely firm and very firm. The substratum to a depth of about 60 inches is mixed dark grayish brown and yellowish brown, very firm silty clay. In some areas the surface layer is silt loam or silty clay loam.

Permeability is very slow, and available water capacity is moderate. Surface runoff is slow. A perched seasonal high water table is at a depth of about 1 to 2 feet in winter and early in spring. Tilth is fair. Tillage is often delayed because the clayey surface layer stays wet and sticky for some time after rainy periods. The shrink-swell potential is high.

Most areas are used for cultivated crops or for tame grass pasture. The rest are used as range. This soil is moderately well suited to wheat, alfalfa, soybeans, and grain sorghum. Crops are damaged during some wet periods. Also, they are adversely affected during dry periods because the clayey subsoil fails to release water readily to plants. A surface bedding system and drainage ditches reduce the wetness. Minimizing tillage and leaving crop residue on the surface conserve moisture and improve fertility and tilth.

This soil is suited to range. The native vegetation dominantly is big bluestem, little bluestem, indiangrass, and switchgrass. In overgrazed areas these grasses are replaced by less productive plants, such as tall dropseed, buffalograss, and western ragweed. Proper stocking rates, restricted use during wet periods, and timely deferment of grazing help to keep the range in good condition. Applications of fertilizer, proper stocking rates, rotation grazing, and a timely season of use

increase forage production in the areas used as tame grass pasture.

This soil is moderately well suited to dwellings and local roads and streets. The wetness and the shrink-swell potential are limitations on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material, however, help to prevent the structural damage caused by wetness and by shrinking and swelling. Low strength and the shrink-swell potential are limitations on sites for local roads and streets. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

This soil is well suited to sewage lagoons. Because of the very slow permeability, however, it generally is unsuitable as a septic tank absorption field.

The capability subclass is IIIw.

prime farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland, pasture, woodland, or other land but is not urban or built-up land or water areas. It either is used for food or fiber or is available for those uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 7 percent. More detailed information about the criteria for prime farmland is available at local offices of the Soil Conservation Service.

About 293,000 acres in Greenwood County, or nearly 40 percent of the total acreage, meets the requirements for prime farmland. This land occurs mainly as areas of the Eram-Labette-Kenoma and Reading-Ivan-Chase associations, which are described under the heading "General soil map units." It also occurs, however, as scattered areas in other parts of the county. About 75,000 acres of this land is used for cultivated crops.

The map units in Greenwood County that are considered prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualitites that affect use and management are described under the heading "Detailed soil map units."

Because they have a seasonal high water table, the Osage and Woodson soils on the following list qualify as prime farmland only in areas where this limitation has been overcome by a drainage system. Onsite evaluation is needed to determine whether or not specific areas of these soils are adequately drained. The Woodson soil generally is adequately drained because of drainage measures or because of the incidental drainage that results from farming, roadbuilding, or other kinds of land development.

The map units that meet the requirements for prime farmland are:

Ca	Chase silty clay loam
De	Dennis silt loam, 1 to 4 percent slopes
Dn	Dennis silt loam, 4 to 7 percent slopes
Ds	Dennis silty clay loam, 2 to 6 percent slopes, eroded
Eb	Eram silty clay loam, 1 to 4 percent slopes
If	Ivan silt loam, occasionally flooded
Ka	Kenoma silt loam, 1 to 4 percent slopes
Ke	Kenoma silty clay loam, 2 to 5 percent slopes, eroded
La	Labette silty clay loam, 1 to 4 percent slopes
Ma	Martin silty clay loam, 1 to 4 percent slopes
Mb	Martin silty clay loam, 4 to 7 percent slopes
Na	Newtonia silt loam, 0 to 2 percent slopes
Os	Osage silty clay (where drained)
Re	Reading silt loam
Wo	Woodson silt loam, 0 to 2 percent slopes (where drained)
Za	Zaar silty clay, 0 to 2 percent slopes

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for the arable soils.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

crops

About 13 percent of the acreage in Greenwood County is used for cultivated crops. The cultivated acreage occurs mainly as areas of Kenoma, Reading, Ivan, Chase, Dennis, and Martin soils. It also occurs, however, as less extensive areas of Eram, Clime, Newtonia, Zaar, Woodson, Osage, and Labette soils. In 1979, sorghum was grown on about 23 percent of the cropland, wheat on 16 percent, soybeans on 15 percent, alfalfa hay on 10 percent, other hay crops on 27 percent, and other crops, mainly corn and oats, on 9 percent (*4*). The acreage used for sorghum and hay has increased in recent years, whereas that used for other crops has remained constant.

The main management needs in the areas used for cultivated crops are measures that help to control erosion and improve tilth and drainage measures.

Soil erosion is a problem on about 42 percent of the cropland in the county. It reduces the productivity of the soil and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on Kenoma, Dennis, Martin, Woodson, and other soils that have a clayey subsoil. Control of erosion not only helps to maintain the productivity of the soil but also helps to maintain the quality of water by minimizing the pollution of streams.

Measures that control erosion provide a protective cover of crops or crop residue, reduce the runoff rate, and increase the infiltration rate. An example is a cropping system that keeps a protective plant cover on the surface for extended periods. Other examples are terraces and diversions, contour farming, and minimum tillage. Terraces and diversions reduce the length of slopes and thus help to control runoff and erosion. They are most practical on deep, well drained soils that have uniform, regular slopes. Contour farming should generally be used in combination with terraces. It is most effective on soils that have smooth, uniform slopes and are suitable for terracing. A system of minimum tillage that

leaves crop residue on the surface increases the infiltration rate and reduces the runoff rate and the hazard of erosion. It is being used on an increasing acreage in the county.

Tilth has an important effect on the germination of seeds and on the infiltration of water into the soil. In this county most of the soils used for crops have a silt loam surface layer that is moderately dark and moderate to low in content of organic matter. Generally, the soil structure is weak, and intense rainfall reduces the infiltration rate and increases the runoff rate. Regularly adding a large amount of crop residue or leaving some of the residue on the surface improves soil structure and helps to prevent surface crusting and excessive erosion. Minimum tillage helps to prevent deterioration of tilth.

A drainage system is needed on some of the soils on flood plains. Unless drained by surface drains or a surface bedding system, some areas of the somewhat poorly drained Chase and poorly drained Osage soils are so wet that yields are reduced.

Information about the design of erosion control measures is available at local offices of the Soil Conservation Service. The latest information about growing crops can be obtained from local offices of the Cooperative Extension Service or the Soil Conservation Service.

pasture

About 7 percent of the acreage in Greenwood County is pastured, mainly with cool season tame grasses, such as tall fescue and smooth bromegrass (*7*). The pastured areas are throughout the county. Some are used only for tame grasses, but others are used for both tame and native grasses.

The main concerns in managing this grassland are maintaining or improving the quality and quantity of forage, controlling erosion, and reducing water loss. Measures that ensure leaf development, root growth, forage regrowth, and food storage in roots are needed.

Proper stocking rates help to keep the pasture in good condition. The number of livestock should be adjusted to the expected level of yields. Generally, about 40 pounds of forage per mature cow per day is needed for continuous seasonal grazing and 35 pounds for rotation grazing. Adjusting the number of livestock allows the pasture to provide forage for the entire grazing season.

Delaying grazing in the spring until the soil is dry and firm helps to prevent trampling and surface compaction. Deferred grazing is needed during the midsummer dormancy of tall fescue and bromegrass. Rotation grazing helps to prevent depletion of the pasture by allowing the grasses to recover after each grazing period.

Providing water and salt at a variety of locations results in a uniform distribution of grazing. Applications of fertilizer increase forage production. The kind and amount of fertilizer should be based on the results of soil tests and on field observations.

Mowing a pasture that has been grazed unevenly or has an excess of forage and spraying with herbicides help to control invading trees, brush, undesirable grasses, and broad-leaved weeds.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil listed for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

Leonard J. Jurgens, range conservationist, Soil Conservation Service, helped prepare this section.

About 535,000 acres in Greenwood County, or about 75 percent of the total acreage, is rangeland. The forage provided by this grassland is supplemented by pasture and native hay in many areas (fig. 13). The rangeland in the western part of the county is mainly the Flint Hills type of rangeland. That in the southeastern part is the northern extension of the Cross Timbers type. That in the eastern and northeastern parts is the Cherokee Prairies type.

Most of the ranches in the county are cow-calf enterprises. Yearlings are raised mainly in the Flint Hills but also in other areas throughout the county. Some stocker-feeder enterprises are in areas where cropland is adjacent to or intermingled with rangeland.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for many soils in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Figure 13.—Native grass baled for use as winter feed for cattle. The soil is Labette silty clay loam, 1 to 4 percent slopes.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Nearly all of the soils in the county have excellent potential for high quality forage plants. Only 20 percent of the rangeland, however, is producing near its potential. Grazing management can restore the potential natural plant community in most areas. About 5 percent of the rangeland is abandoned cropland that can be restored to the natural plant community by range seeding. On about 20 percent of the rangeland, brush control is needed to help restore the natural plant community. The brush is especially a problem on the Savannah, Shallow Savannah, and Limy Upland range sites. On these sites brush control, grazing management, and range seeding are needed.

woodland management and productivity

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

About 19,100 acres in Greenwood County, or 2.6 percent of the total acreage, is forested. The woodland occurs as scattered small tracts along streams, in upland drainageways, and on upland slopes where the soils are underlain by shale or sandstone. Also, many trees grow along farm boundaries and fence rows. Hedgerows are common throughout the county.

The woodland in the uplands is oak-hickory forest. The forest cover types are post oak-blackjack oak, elm-ash-locust, and oak-hickory. The main species are post oak, blackjack oak, Siberian elm, osageorange, eastern

redcedar, hackberry, red mulberry, sumac, and flowering dogwood. Post oak and blackjack oak are common on Darnell and Niotaze soils. They are low quality trees, but they have some value as firewood.

The woodland along the major streams is bottomland hardwoods forest. The forest cover type is lowland plains hardwoods. The main species are black walnut, hackberry, bur oak, silver maple, boxelder, green ash, pecan, eastern cottonwood, northern red oak, and hickory (fig. 14). Chase, Ivan, Osage, and Reading soils are on the bottom land in the county. In many areas they have good potential for the trees used for high value wood products, such as walnut veneer. The trees have higher value and grow within a shorter period than those on upland soils.

Figure 14.—A stand of oak and hackberry in an area of Ivan silt loam, occasionally flooded.

The soils in Greenwood County generally have good potential for Christmas trees and for the trees used for veneer, sawtimber, firewood, and fenceposts. Most of the acreage, however, is cropland or rangeland that is unlikely to be converted to woodland. Mainly because of the conversion of woodland to cropland or pasture, the wooded acreage has been steadily declining during recent years. Only a small part of the woodland is managed for commercial wood products because most of the wooded areas are small, privately owned acreages on individual farms.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

Landowners have established windbreaks and environmental plantings on most of the homesites and farmsteads in Greenwood County. Some of the trees were already on the site when the farmstead was established. The most common species are Siberian elm, green ash, eastern cottonwood, hackberry, eastern redcedar, northern catalpa, pecan, black walnut, red mulberry, and lilac.

Tree planting is a continual need because old trees deteriorate and die, because insects, diseases, and storms destroy some trees, and because windbreaks and environmental plantings are needed on new homesites and in areas where farming or ranching is expanding. Windbreaks are especially important because they reduce energy requirements.

In order for windbreaks or environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Selecting suitable species helps to ensure survival and a maximum growth rate. The growth rate is greatly affected by the permeability, available water capacity, and fertility of the soil.

Trees and shrubs can be easily established on most of the soils in the county. Competition from weeds and grasses is the main problem. It can be controlled,

however, by proper site preparation before the trees or shrubs are planted and by measures that remove the competing plants after the windbreaks or environmental plantings are established.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, keep snow from blowing off the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The Fall River and Toronto Reservoirs, other water areas, and the Flint Hills are the chief recreational resources in Greenwood County. The reservoirs draw large numbers of visitors during the summer, especially on weekends. Good public facilities are provided for fishing, boating, camping, picnicking, and swimming. Several watershed lakes, farm ponds, and the Fall and Verdigris Rivers provide opportunities for water sports (fig. 15). The rolling bluestem grasslands of the Flint Hills, which have many limestone outcrops, clear streams, and wooded streambanks, are uniquely beautiful during all seasons. The potential for further recreational development within the county is good.

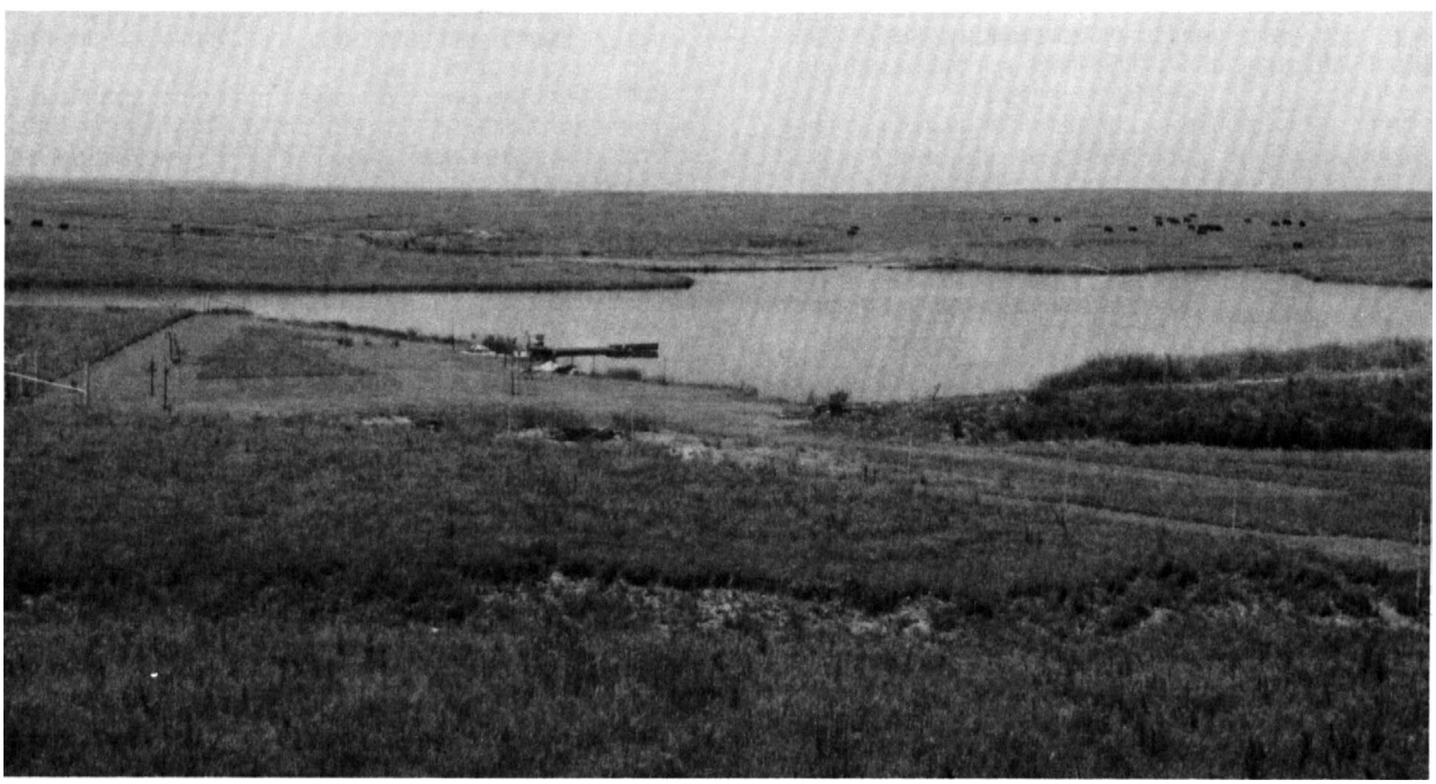

Figure 15.—A farm pond used not only as a source of livestock water but also for recreation.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

wildlife habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Greenwood County are bobwhite quail, mourning dove, cottontail rabbit, white-tailed deer, and several species of waterfowl. There is also a good population of prairie chickens and wild turkeys.

Nongame species are numerous because the habitat types are diverse. Cropland, woodland, and grassland are interspersed throughout the county. Each of these kinds of land provides habitat for a particular group of species.

Furbearers are sparse to common along the Fall and Verdigris Rivers and their tributaries. They are trapped on a limited basis.

The Fall River and Toronto Reservoirs and the many watershed lakes, stock water ponds, and streams provide good to excellent fishing. The species commonly caught are largemouth bass, bluegill, carp, channel catfish, bullhead, and flathead catfish. Also, walleye and several species of bass are caught at the reservoirs.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that

limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, grain sorghum, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, switchgrass, indiangrass, grama, sunflowers, goldenrod, ragweed, and native legumes.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, hackberry, sycamore, cottonwood, black walnut, mulberry, hickory, ash, and willow. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are plum, fragrant sumac, Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, redcedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are plum, dogwood, buckbrush, gooseberry, blackberry, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, indigobush, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, and cottontail rabbit.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include owls, hawks, wild turkeys, thrushes, woodpeckers, squirrels, opossum, raccoons, and white-tailed deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyotes, jackrabbits, hawks, vultures, badgers, killdeer, meadowlarks, and prairie chickens.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from local offices of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and the Cooperative Extension Service.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed

performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not

favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69.

The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months;

November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate, or high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

engineering index test data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiudolls (*Argi*, meaning argillic horizon, plus *udoll*, the suborder of the Mollisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Argiudolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*5*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*6*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Chase series

The Chase series consists of deep, somewhat poorly drained, slowly permeable soils on low terraces. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Chase soils are similar to Osage soils and commonly are adjacent to Ivan, Osage, and Reading soils. The poorly drained Osage soils are on flood plains. They do not have an argillic horizon, and their surface layer is more clayey than that of the Chase soils. Ivan and Reading soils are less clayey in the subsoil than the

Chase soils. Ivan soils are adjacent to stream channels, and Reading soils are on rarely flooded terraces.

Typical pedon of Chase silty clay loam, 2,600 feet east and 150 feet south of the northwest corner of sec. 21, T. 25 S., R. 13 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable, hard; few fine roots; neutral; clear smooth boundary.

A—7 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine granular; friable, hard; few fine roots; slightly acid; gradual smooth boundary.

BA—14 to 22 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; firm, very hard; few fine roots; slightly acid; gradual smooth boundary.

Bt1—22 to 28 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very firm, very hard; clay films on faces of peds; few fine roots; medium acid; gradual smooth boundary.

Bt2—28 to 45 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; many fine distinct dark yellowish brown (10YR 4/6) mottles below a depth of 30 inches; moderate fine subangular blocky structure; clay films on faces of peds; extremely firm, extremely hard; few black stains in the lower part; neutral; gradual smooth boundary.

C—45 to 60 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 6/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; few black stains and concretions; extremely firm, extremely hard; mildly alkaline.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon is more than 36 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is dominantly silty clay loam but in some pedons is silt loam. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (4 to 6 dry), and chroma of 1 or 2. It is silty clay loam or silty clay. It ranges from medium acid to neutral.

Clime series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in residuum of calcareous, clayey shale. Slopes range from 3 to 30 percent.

Clime soils commonly are adjacent to Martin and Sogn soils. Martin soils have an argillic horizon and are more than 40 inches deep over shale. They generally are on side slopes below the Clime soils. Sogn soils are less than 20 inches deep over limestone. They generally are higher on the landscape than the Clime soils.

Typical pedon of Clime silty clay, in an area of Clime-Sogn complex, 5 to 20 percent slopes, 2,100 feet west and 700 feet north of the southeast corner of sec. 21, T. 26 S., R. 10 E.

A--0 to 11 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong fine granular structure; firm, hard; common fine roots; moderately alkaline; slight effervescence; clear smooth boundary.

Bw—11 to 23 inches; dark gray (10YR 4/1) and light olive brown (2.5Y 5/4) silty clay, gray (10YR 5/1) and light yellowish brown (2.5Y 6/4) dry; strong fine subangular blocky structure; very firm, very hard; common fine roots; moderately alkaline; strong effervescence; gradual smooth boundary.

C—23 to 33 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (10YR 6/2) dry; common fine distinct light olive brown (2.5Y 5/6) mottles; moderate fine subangular blocky structure; many soft lime accumulations; few fine roots; extremely firm, extremely hard; moderately alkaline; strong effervescence; gradual wavy boundary.

Cr—33 inches; calcareous gray shale.

The thickness of the solum ranges from 12 to 30 inches and the depth to shale from 20 to 40 inches. The depth to lime ranges from 0 to 10 inches. The mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silty clay, silty clay loam, or stony silty clay loam. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 4. It is silty clay, clay, or silty clay loam. The content of clay in this horizon is 37 to 50 percent. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is silty clay or clay.

Darnell series

The Darnell series consists of shallow, well drained, moderately rapidly permeable soils on uplands. These soils formed in residuum of sandstone. Slopes range from 0 to 35 percent.

Darnell soils are similar to Sogn soils and commonly are adjacent to Niotaze and Steedman soils. Sogn soils are more silty throughout than the Darnell soils and formed in residuum of limestone. Niotaze and Steedman soils are 20 to 40 inches deep over bedrock. Niotaze soils are on the lower side slopes, and Steedman soils are on the higher parts of the landscape.

Typical pedon of Darnell fine sandy loam, in an area of Niotaze-Darnell complex, 6 to 35 percent slopes, 2,350 feet west and 450 feet north of the southeast corner of sec. 12, T. 27 S., R. 12 E.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable; many fine roots; strongly acid; clear smooth boundary.

Bw—6 to 16 inches; brown (7.5YR 4/4) fine sandy loam, brown (7.5YR 5/4) dry; weak fine granular structure; slightly hard, very friable; common fine roots; about 5 percent sandstone fragments less than 1 inch in diameter; strongly acid; gradual wavy boundary.

Cr—16 inches; sandstone.

The thickness of the solum and the depth to sandstone bedrock range from 10 to 20 inches. Reaction is neutral to strongly acid throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 to 4. In this horizon the content of sandstone fragments more than 3 inches in diameter is, by volume, less than 15 percent. The Bw horizon has hue of 5YR or 7.5YR, value of 4 to 6 (5 to 7 dry), and chroma of 3 to 6. It is fine sandy loam or loam. In this horizon the content of sandstone fragments less than 3 inches in diameter is, by volume, less than 20 percent. A few pedons have a C horizon.

Dennis series

The Dennis series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in residuum of shale or in colluvium. Slopes range from 1 to 7 percent.

Dennis soils are similar to Eram, Kenoma, and Newtonia soils and commonly are adjacent to Eram and Kenoma soils. Eram soils are 20 to 40 inches deep over bedrock. They are on side slopes above the Dennis soils. Kenoma soils lack a B1 horizon. They are on ridgetops. Newtonia soils are less clayey in the upper part of the subsoil than the Dennis soils.

Typical pedon of Dennis silt loam, 4 to 7 percent slopes (fig. 16), 2,100 feet north and 500 feet west of the southeast corner of sec. 18, T. 25 S., R. 11 E.

A—0 to 12 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable, hard; many fine roots; medium acid; clear smooth boundary.

BA—12 to 17 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; strong fine subangular blocky structure; firm, hard; many fine roots; medium acid; gradual smooth boundary.

Bt1—17 to 25 inches; brown (10YR 4/3) silty clay, yellowish brown (10YR 5/4) dry; few medium distinct red (2.5YR 4/6) mottles; strong fine and medium subangular blocky structure; firm, very hard; common fine roots; few black stains; clay films on faces of most peds; medium acid; gradual smooth boundary.

Figure 16.—Typical profile of Dennis silt loam. The arrow indicates the depth to the clayey subsoil. Depth is marked in feet.

Bt2—25 to 33 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; many coarse distinct red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm, very hard; common fine roots; few black stains and concretions; clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—33 to 45 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; few medium faint dark grayish brown (10YR 4/2) and common medium distinct yellowish red (5YR 4/6) mottles; moderate fine blocky structure; very firm, extremely hard; few fine roots; common black stains and concretions; thick continuous clay films on faces of peds; slightly acid; diffuse smooth boundary.

BC—45 to 60 inches; yellowish brown (10YR 5/6) silty clay; few streaks of dark grayish brown (10YR 4/2) material; common medium distinct yellowish red (5YR 4/6) mottles; weak fine blocky structure; extremely firm, extremely hard; common black stains and concretions; mildly alkaline.

The solum is more than 60 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2 or 3. It is dominantly silt loam but in some pedons is silty clay loam or loam. It is strongly acid or medium acid. The BA horizon has hue of 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 3 or 4. It is silty clay loam or clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 (5 or 6 dry), and chroma of 3 to 6. It is silty clay loam, silty clay, or clay. It ranges from slightly acid to strongly acid.

Dennis silty clay loam, 2 to 6 percent slopes, eroded, is a taxadjunct because it lacks a mollic epipedon and is slightly less acid than is defined as the range for the Dennis series. These differences, however, do not significantly affect the use or behavior of the soil.

Dwight series

The Dwight series consists of deep, moderately well drained, very slowly permeable, sodic soils on uplands. These soils formed in clayey sediments. Slopes range from 0 to 3 percent.

Dwight soils are similar to Kenoma and Woodson soils and commonly are adjacent to Clime, Florence, and Labette soils. Unlike all of those soils, they have a natric horizon. The surface layer of Kenoma and Woodson soils is thicker than that of the Dwight soils. The calcareous Clime soils are 20 to 40 inches deep over shale. They are on side slopes. Florence soils are on side slopes below the Dwight soils. Their content of angular chert fragments is more than 35 percent. Labette soils are 20 to 40 inches deep over limestone. Their positions on the landscape are similar to those of the Dwight soils.

Typical pedon of Dwight silt loam, 0 to 2 percent slopes, 1,850 feet west and 900 feet north of the southeast corner of sec. 7, T. 22 S., R. 10 E.

A—0 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; gray silt coatings in the lower 2 inches; many fine roots; friable, hard; medium acid; abrupt smooth boundary.

Btn1—4 to 16 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine and medium blocky structure; extremely firm, extremely hard; common fine roots along faces of peds; clay films on faces of peds; neutral; gradual smooth boundary.

Btn2—16 to 23 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; weak fine blocky structure; extremely firm, extremely hard; few fine roots along faces of peds; clay films on faces of peds; few small chert fragments less than one-quarter inch in size; moderately alkaline; gradual smooth boundary.

BC—23 to 32 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; weak fine blocky structure; extremely firm, extremely hard; few fine roots in the upper part; few small chert fragments less than one-quarter inch in size; few fine black stains; moderately alkaline; gradual smooth boundary.

C—32 to 44 inches; dark brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) dry; massive; very firm, extremely hard; few fine black stains and concretions; common chert and limestone fragments less than one-half inch in size; moderately alkaline; abrupt wavy boundary.

2R—44 inches; hard limestone.

The thickness of the solum ranges from 30 to 55 inches. The depth to hard limestone or shale is 40 to 60 inches. The mollic epipedon is 15 to 30 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (4 dry), and chroma of 1 or 2. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR to 5YR, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. It is clay or silty clay. It ranges from slightly acid to moderately alkaline.

Eram series

The Eram series consists of moderately deep, moderately well drained, slowly permeable soils on uplands. These soils formed in residuum of shale. Slopes range from 1 to 7 percent.

Eram soils are similar to Dennis, Martin, and Steedman soils and commonly are adjacent to Dennis, Kenoma, Sogn, and Steedman soils. Dennis, Kenoma, and Martin soils are more than 40 inches deep over bedrock. Dennis and Martin soils generally are lower on the landscape than the Eram soils, and Kenoma soils are on broad ridgetops. Steedman soils lack a mollic

epipedon. Sogn soils are less than 20 inches deep over limestone. They generally are higher on the landscape than the Eram soils.

Typical pedon of Eram silty clay loam, 1 to 4 percent slopes, 1,850 feet south and 700 feet east of the northwest corner of sec. 7, T. 25 S., R. 11 E.

A—0 to 10 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; strong medium granular structure; friable, hard; many fine roots; slightly acid; clear smooth boundary.

Bt1—10 to 18 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; moderate fine subangular blocky structure; very firm, extremely hard; many fine roots; thin patchy clay films on faces of most peds; slightly acid; gradual smooth boundary.

Bt2—18 to 26 inches; very dark grayish brown (2.5YR 3/2) and olive brown (2.5Y 4/4) silty clay, dark grayish brown (2.5Y 4/2) and light olive brown (2.5Y 5/4) dry; moderate fine subangular blocky structure; thin continuous clay films on faces of most peds; very firm, very hard; common fine roots; neutral; gradual smooth boundary.

BC—26 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; common fine faint light olive brown (2.5Y 5/6) mottles; moderate fine subangular blocky structure; few shale fragments; common fine roots; firm, very hard; few black stains; neutral; gradual wavy boundary.

Cr—33 inches; olive brown (2.5Y 4/4) shale.

The thickness of the solum, or the depth to shale, ranges from 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 2 or 3. It is slightly acid or medium acid. It is dominantly silty clay loam, but the range includes silt loam and clay loam. The Bt horizon has hue of 7.5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. It ranges from strongly acid to neutral. It is clay loam, silty clay loam, or silty clay. In some pedons seams of lime are in the lower part of the Bt horizon and in the Cr horizon.

Florence series

The Florence series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in residuum of cherty limestone (fig. 17). Slopes range from 2 to 12 percent.

Florence soils are similar to Olpe soils and commonly are adjacent to Dwight, Labette, and Martin soils. Olpe soils contain rounded, waterworn chert pebbles and are more than 60 inches deep over bedrock. The content of chert fragments in the solum of Dwight, Labette, and Martin soils is less than 10 percent. Dwight soils are on ridgetops, Labette soils are in positions on the landscape similar to those of the Florence soils, and Martin soils are on foot slopes.

Typical pedon of Florence cherty silt loam, in an area of Florence-Labette complex, 2 to 12 percent slopes, 1,300 feet west of the northeast corner of sec. 24, T. 23 S., R. 8 E.

Figure 17.—Profile of Florence cherty silt loam. Depth is marked in feet.

A—0 to 13 inches; very dark brown (10YR 2/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; very friable, hard; about 40 percent chert fragments 1/4 inch to 2 inches in size; many fine roots; neutral; gradual smooth boundary.

BA—13 to 19 inches; dark brown (7.5YR 3/2) very cherty silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; friable, hard; about 70 percent chert fragments 1/2 inch to 3 inches in size; many fine roots; slightly acid; gradual smooth boundary.

Bt1—19 to 32 inches; reddish brown (5YR 4/4 moist or dry) very cherty clay; strong fine subangular blocky structure; extremely firm, extremely hard; about 80 percent chert fragments as much as 7 inches in size; common fine roots; slightly acid; gradual irregular boundary.

Bt2—32 to 40 inches; yellowish red (5YR 4/6 moist or dry) very cherty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; strong fine subangular blocky structure; extremely firm, extremely hard; about 50 percent chert fragments as much as 4 inches in size; few fine roots; slightly acid; clear irregular boundary.

BC—40 to 45 inches; reddish brown (5YR 4/4 moist or dry) cherty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; strong fine subangular blocky structure; very firm, extremely hard; about 20 percent chert fragments 1/2 inch to 2 inches in size; few fine roots; few black stains and concretions; neutral; clear wavy boundary.

R—45 inches; cherty limestone.

The thickness of the solum, or the depth to limestone, ranges from 40 to 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It typically is cherty silt loam but in some pedons is cherty silty clay loam, silt loam, or silty clay loam. It ranges from medium acid to neutral. The BA horizon has hue of 7.5YR or 5YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is cherty silty clay loam or cherty silty clay. It ranges from medium acid to neutral. The Bt horizon has hue of 7.5YR, 5YR, or 2.5YR, value of 3 to 5 (4 or 5 dry), and chroma of 3 to 6. It ranges from slightly acid to mildly alkaline. The content of chert fragments in this horizon ranges from 50 to 85 percent.

Ivan series

The Ivan series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty recent alluvium. Slopes range from 0 to 2 percent.

Ivan soils are similar to Reading soils and commonly are adjacent to Chase and Reading soils. Reading soils have an argillic horizon. They are on rarely flooded terraces above the Ivan soils. The somewhat poorly drained Chase soils are on low terraces and are farther from stream channels than the Ivan soils. Also, they have a more clayey subsoil.

Typical pedon of Ivan silt loam, occasionally flooded, 900 feet east and 2,600 feet north of the southwest corner of sec. 11, T. 26 S., R. 10 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine granular structure; very friable, hard; slight effervescence; mildly alkaline; clear smooth boundary.

A—7 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable, hard; few worm casts and pores; few lenses of yellowish brown (10YR 5/4) material; slight effervescence; moderately alkaline; gradual smooth boundary.

AC—16 to 38 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable, hard; many pores; slight effervescence; moderately alkaline; gradual smooth boundary.

C—38 to 60 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; very friable, hard; many pores; slight effervescence; moderately alkaline.

The solum ranges from 24 to 50 inches in thickness. The depth to lime ranges from 0 to 10 inches. The upper 10 inches is mildly alkaline or moderately alkaline, and the rest of the profile is moderately alkaline.

The A and AC horizons have hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 to 3. They are dominantly silt loam, but the range includes silty clay loam. The C horizon has hue of 10YR or 7.5YR, value of 3 to 5 (5 to 7 dry), and chroma of 2 or 3. It is dominantly loam, silt loam, or silty clay loam. In some pedons, however, it has strata containing more clay or more sand below a depth of 40 inches.

Kenoma series

The Kenoma series consists of deep, moderately well drained, very slowly permeable soils on uplands and high terraces. These soils formed in old alluvial sediments or in residuum of shale. Slopes range from 1 to 5 percent.

Kenoma soils are similar to Dennis, Dwight, Labette, and Woodson soils and commonly are adjacent to Dennis, Labette, Olpe, and Woodson soils. Dennis and Labette soils have a BA horizon. Also, Labette soils are 20 to 40 inches deep over bedrock. Dwight soils have a natric horizon. Olpe soils generally are more sloping than the Kenoma soils. The content of chert gravel in their subsoil is more than 35 percent. Woodson soils generally are less sloping than the Kenoma soils. Also, they have a grayer subsoil.

Typical pedon of Kenoma silt loam, 1 to 4 percent slopes, 2,150 feet south and 1,300 feet east of the northwest corner of sec. 9, T. 26 S., R. 13 E.

A—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; gray coatings in the lower 3 inches; moderate fine granular structure; friable, hard; many fine roots; slightly acid; abrupt smooth boundary.
Bt—11 to 26 inches; very dark brown (10YR 2/2) silty clay, dark grayish brown (10YR 4/2) dry; many fine distinct dark brown (7.5YR 3/2) mottles; moderate fine subangular blocky structure; very firm, extremely hard; common fine roots; slightly acid; gradual smooth boundary.
BC—26 to 33 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; common fine faint very dark grayish brown (10YR 3/2) mottles; moderate fine subangular blocky structure; very firm, very hard; few fine roots; few fine black concretions; neutral; clear smooth boundary.
C—33 to 60 inches; dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/4) silty clay loam, yellowish brown (10YR 5/6) and light yellowish brown (10YR 6/4) dry; few medium distinct yellowish red (5YR 4/6) mottles; weak fine blocky structure; firm, very hard; few black stains and streaks; few lime concretions; neutral.

The thickness of the solum ranges from 30 to 60 inches. In some pedons the content of waterworn chert gravel is as much as 20 percent. In a few pedons limestone or shale is at a depth of 40 to 60 inches.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 to 3. It is dominantly silt loam but in some pedons is silty clay loam. It ranges from strongly acid to slightly acid. The boundary between the A and Bt horizons is abrupt or clear. The Bt horizon is silty clay or clay in which the content of clay is 40 to 60 percent. It ranges from medium acid to mildly alkaline. In the upper part it has hue of 10YR or 7.5YR, value of 2 or 3 (4 or 5 dry), and chroma of 2 or 3. In the lower part it has hue of 10YR or 7.5YR, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 6.

Labette series

The Labette series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in residuum of interbedded limestone and clayey shale. Slopes range from 0 to 8 percent.

Labette soils are similar to Kenoma and Martin soils and commonly are adjacent to Dwight, Florence, Kenoma, and Sogn soils. Kenoma soils lack a B1 horizon and are more than 40 inches deep over bedrock. Martin soils also are more than 40 inches deep over bedrock. Their mollic epipedon is more than 20 inches thick. Dwight soils are on ridgetops and generally are higher on the landscape than the Labette soils. Also, they have a thinner A horizon and have a natric horizon. Florence soils are on side slopes below the Labette soils. The content of chert fragments in their subsoil is more than 35 percent. Sogn soils are less than 20 inches deep over limestone. They are lower on the landscape than the Labette soils.

Typical pedon of Labette silty clay loam, 1 to 4 percent slopes, 2,300 feet south and 100 feet west of the northeast corner of sec. 9, T. 23 S., R. 13 E.

A—0 to 9 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; strong fine and medium granular structure; friable, hard; many fine roots; slightly acid; clear smooth boundary.
BA—9 to 14 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) dry; few fine distinct yellowish red (5YR 5/8) mottles; strong fine granular structure; firm, very hard; many fine roots; slightly acid; gradual smooth boundary.
Bt1—14 to 19 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) dry; few fine distinct yellowish red (5YR 5/8) mottles; strong fine subangular blocky structure; firm, very hard; common fine roots; thin patchy clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.
Bt2—19 to 31 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 4/4) dry; moderate fine subangular blocky structure; very firm, extremely hard; common fine roots; thick continuous clay films on faces of peds; few fine black stains and concretions; neutral; abrupt wavy boundary.
R—31 inches; hard limestone.

The thickness of the solum, or the depth to limestone, ranges from 20 to 40 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silty clay loam or silt loam. It is medium acid or slightly acid. The Bt horizon has hue of 7.5YR or 5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It ranges from slightly acid to mildly alkaline. It is silty clay loam or silty clay in which the content of clay is 35 to 50 percent.

Martin series

The Martin series consists of deep, moderately well drained, slowly permeable soils on uplands and foot slopes. These soils formed in residuum of clayey shale or in colluvium. Slopes range from 1 to 7 percent.

Martin soils are similar to Eram, Labette, Woodson, and Zaar soils and commonly are adjacent to Clime, Eram, and Woodson soils. Eram and Labette soils are 20 to 40 inches deep over bedrock. The nearly level Woodson soils are on uplands. Their content of clay

increases abruptly between the surface layer and the subsoil. Zaar soils do not have an argillic horizon. They are nearly level and are on foot slopes and high terraces. The calcareous Clime soils are 20 to 40 inches deep over shale and do not have an argillic horizon. They are on the upper side slopes.

Typical pedon of Martin silty clay loam, 4 to 7 percent slopes, 400 feet east and 600 feet south of the northwest corner of sec. 5, T. 22 S., R. 10 E.

A—0 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong fine and medium granular structure; firm, hard; many fine roots; slightly acid; gradual smooth boundary.

BA—11 to 18 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong fine and medium subangular blocky structure; very firm, very hard; many fine roots; slightly acid; gradual smooth boundary.

Bt—18 to 35 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine faint olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; extremely firm, extremely hard; few fine roots; clay films on faces of peds; neutral; gradual smooth boundary.

BC—35 to 52 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; extremely firm, extremely hard; few fine roots; neutral; gradual smooth boundary.

C—52 to 60 inches; dark brown (7.5YR 4/4) clay, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; extremely firm, extremely hard; few chert fragments less than one-half inch in size; mildly alkaline.

The solum ranges from 40 to 60 inches in thickness. The depth to shale or clay beds is more than 40 inches. The mollic epipedon ranges from 24 to 36 inches in thickness. Some pedons have a few lime concretions in the lower part of the B horizon and in the C horizon.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is dominantly silty clay loam but in some pedons is silty clay. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. It is medium acid to neutral. It is clay or silty clay in which the content of clay is 40 to 55 percent.

Newtonia series

The Newtonia series consists of deep, well drained, moderately permeable soils on old high terraces. These soils formed in loamy and clayey sediments. Slopes range from 0 to 2 percent.

Newtonia soils are similar to Dennis and Reading soils and commonly are adjacent to those soils. The moderately well drained Dennis soils generally are more sloping than the Newtonia soils. Also, they are more clayey in the upper part of the subsoil. Reading soils are on rarely flooded terraces. Their subsoil is not so red as that of the Newtonia soils.

Typical pedon of Newtonia silt loam, 0 to 2 percent slopes, 2,200 feet south and 150 feet west of the northeast corner of sec. 28, T. 25 S., R. 13 E.

Ap—0 to 8 inches; dark brown (7.5YR 3/2) silt loam, brown (10YR 4/3) dry; weak fine granular structure; very friable, slightly hard; few fine roots; slightly acid; clear smooth boundary.

A—8 to 12 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 4/2) dry; strong fine granular structure; very friable, hard; slightly acid; gradual smooth boundary.

BA—12 to 18 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 5/4) dry; strong fine subangular blocky structure; firm, hard; slightly acid; gradual smooth boundary.

Bt1—18 to 26 inches; reddish brown (5YR 4/4) silty clay loam, yellowish red (5YR 5/6) dry; few fine distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm, very hard; few black stains; clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—26 to 45 inches; dark red (2.5YR 3/6) silty clay loam, red (2.5YR 4/6) dry; few medium distinct brown (10YR 4/3) mottles; moderate fine subangular blocky structure; very firm, very hard; few black stains; clay films on faces of peds; few pebbles less than 1 inch in size; strongly acid; gradual smooth boundary.

Bt3—45 to 60 inches; yellowish red (5YR 4/6) silty clay, yellowish red (5YR 5/6) dry; weak fine subangular blocky structure; very firm, extremely hard; few black stains; medium acid.

The solum is more than 60 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 to 3. It is dominantly silt loam but in some pedons is silty clay loam. It is slightly acid or medium acid. The BA horizon has hue of 7.5YR or 5YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 to 4. It is silt loam or silty clay loam. It ranges from slightly acid to strongly acid. The Bt horizon has hue of 5YR or 2.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 3 to 6. It is silty clay loam in the upper part and silty clay loam or silty clay in the lower part. It is medium acid or strongly acid.

Niotaze series

The Niotaze series consists of moderately deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in residuum of shale interbedded with sandstone. Slopes range from 3 to 35 percent.

Niotaze soils are similar to Steedman soils and commonly are adjacent to Darnell and Steedman soils. Steedman soils lack an E horizon and are less acid than the Niotaze soils. Also, they generally are higher on the landscape. Darnell soils are less than 20 inches deep over sandstone. They are on ridgetops and side slopes above the Niotaze soils.

Typical pedon of Niotaze loam, in an area of Niotaze-Darnell complex, 0 to 6 percent slopes, 1,300 feet north and 2,200 feet west of the southeast corner of sec. 3, T. 28 S., R. 13 E.

A—0 to 3 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable, hard; many fine roots; strongly acid; clear smooth boundary.

E—3 to 9 inches; brown (7.5YR 4/2) loam, light brown (7.5YR 6/3) dry; weak fine granular structure; very friable, hard; many fine pores; common fine roots; strongly acid; abrupt smooth boundary.

2Bt—9 to 22 inches; dark reddish brown (5YR 3/3) clay, reddish brown (5YR 4/3) dry; dark reddish brown (2.5YR 3/4) in interior of peds; moderate fine and medium subangular blocky structure; very firm, extremely hard; thick continuous clay films on faces of peds; common fine roots; slightly acid; gradual smooth boundary.

2BC—22 to 27 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 4/4) dry; few fine distinct grayish brown (10YR 5/2) mottles below a depth of 24 inches; moderate fine subangular blocky structure; very firm, extremely hard; thin patchy clay films on faces of peds; few fine roots; neutral; clear wavy boundary.

2Cr—27 inches; clayey shale.

The thickness of the solum, or the depth to shale, ranges from 20 to 40 inches.

The A horizon has hue of 10YR, value of 2 to 4 (4 to 6 dry), and chroma of 1 to 3. It is dominantly loam but in some pedons is fine sandy loam, silty loam, or the cobbly or stony analogs of those textures. It is medium acid or strongly acid. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6 (5 to 7 dry), and chroma of 2 or 3. Its texture and reaction are similar to those of the A horizon. The content of sandstone fragments in the A and E horizons is less than 35 percent. The Bt horizon has hue of 2.5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 3 to 6. It ranges from slightly acid to very strongly acid. It is silty clay loam, silty clay, or clay. The content of clay in this horizon ranges from 35 to 55 percent.

Olpe series

The Olpe series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in old gravelly alluvium. Slopes range from 4 to 15 percent.

Olpe soils are similar to Florence soils and commonly are adjacent to Eram and Kenoma soils. Florence soils contain angular chert rocks and are 40 to 60 inches deep over limestone. Eram soils are 20 to 40 inches deep over shale and do not contain chert gravel. They generally are lower on the landscape than the Olpe soils. Kenoma soils generally are less sloping than the Olpe soils. The content of gravel in their subsoil is less than 20 percent.

Typical pedon of Olpe gravelly silt loam, 4 to 15 percent slopes, 2,300 feet north and 150 feet east of the southwest corner of sec. 34, T. 22 S., R. 13 E.

A—0 to 13 inches; dark brown (7.5YR 3/2) gravelly silt loam, dark brown (7.5YR 4/2) dry; strong fine granular structure; friable, hard; common fine roots; about 15 percent rounded chert gravel; slightly acid; clear wavy boundary.

BA—13 to 19 inches; dark brown (7.5YR 3/2) very gravelly silty clay loam, dark brown (7.5YR 4/2) dry; strong fine granular structure; firm, hard; few fine roots; about 85 percent rounded chert gravel; slightly acid; gradual smooth boundary.

Bt1—19 to 32 inches; reddish brown (5YR 4/4) very gravelly silty clay, reddish brown (5YR 5/4) dry; strong fine subangular blocky structure; very firm, extremely hard; few fine roots; about 85 percent rounded chert gravel; clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—32 to 50 inches; dark red (2.5YR 3/6) very gravelly clay, red (2.5YR 4/6) dry; moderate fine subangular blocky structure; very firm, extremely hard; few fine roots; about 80 percent rounded chert gravel; clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—50 to 60 inches; dark red (2.5YR 3/6) gravelly clay, red (2.5YR 4/6) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; strong medium blocky structure; very firm, extremely hard; clay films on faces of peds; few fine black stains; few fine roots; about 40 percent rounded chert gravel; slightly acid.

The solum is more than 60 inches thick. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It is dominantly gravelly silt loam but in some pedons is silt loam. It is strongly acid to slightly acid. The Bt horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 4 to 6. It is medium acid to neutral. It is very gravelly silty clay or very gravelly clay in the upper part and very gravelly silty clay, gravelly silty clay, very gravelly clay, or gravelly clay in the lower part. The content of gravel ranges from 50 to 90 percent in the upper part and from 35 to 75 percent in the lower part.

Osage series

The Osage series consists of deep, poorly drained, very slowly permeable soils on flood plains. These soils formed in a thick layer of clayey alluvium. Slopes are 0 to 1 percent.

Osage soils are similar to Chase and Zaar soils and commonly are adjacent to Chase and Ivan soils. Chase soils are on low terraces. Their surface layer is less clayey than that of the Osage soils. The calcareous Ivan soils are closer to stream channels than the Osage soils. Also, they have a less clayey subsoil. The somewhat poorly drained Zaar soils are on uplands.

Typical pedon of Osage silty clay, 1,200 feet north and 50 feet west of the southeast corner of sec. 28, T. 25 S., R. 13 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak medium granular structure; very firm, extremely hard; neutral; clear smooth boundary.

A—8 to 14 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium granular structure; very firm, extremely hard; neutral; gradual smooth boundary.

Bw—14 to 35 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; extremely firm, extremely hard; few fine gypsum crystals in the lower part; mildly alkaline; gradual smooth boundary.

BC—35 to 53 inches; mixed very dark grayish brown (2.5Y 3/2) and very dark gray (10YR 3/1) silty clay, dark grayish brown (2.5Y 4/2) and dark gray (10YR 4/1) dry; few fine faint brown (10YR 4/3) mottles; moderate fine blocky structure; extremely firm, extremely hard; few lime accumulations and gypsum crystals; mildly alkaline; diffuse smooth boundary.

C—53 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; common medium distinct light olive brown (2.5Y 5/6) mottles; weak fine blocky structure; extremely firm, extremely hard; common fine and medium lime accumulations and concretions, which increase in number with increasing depth; mildly alkaline; slight effervescence.

The solum is more than 40 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is dominantly silty clay but in some pedons is silty clay loam. It ranges from strongly acid to neutral. The Bw horizon has hue of 10YR or 2.5Y, value of 3 (4 dry), and chroma of less than 2. It ranges from medium acid to mildly alkaline.

Reading series

The Reading series consists of deep, well drained, moderately slowly permeable soils on terraces. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Reading soils are similar to Ivan and Newtonia soils and commonly are adjacent to Chase and Ivan soils. The calcareous Ivan soils do not have an argillic horizon. They are on flood plains. Newtonia soils are redder than the Reading soils. The somewhat poorly drained Chase soils are on low terraces. Their subsoil is more clayey than that of the Reading soils.

Typical pedon of Reading silt loam, 2,200 feet south and 600 feet west of the northeast corner of sec. 11, T. 22 S., R. 11 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable, slightly hard; few fine roots; common fine pores; slightly acid; clear smooth boundary.

A—8 to 13 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; friable, hard; few fine roots; slightly acid; gradual smooth boundary.

BA—13 to 18 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine subangular blocky structure; firm, hard; slightly acid; gradual smooth boundary.

Bt1—18 to 30 inches; dark brown (10YR 3/3) silty clay loam, dark brown (10YR 4/3) dry; strong fine and medium subangular blocky structure; firm, very hard; few fine pores; thin clay films on faces of most peds; slightly acid; gradual smooth boundary.

Bt2—30 to 44 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; firm, hard; common fine pores; clay films on faces of peds; slightly acid; gradual smooth boundary.

C—44 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm, very hard; few threads of lime; neutral.

The thickness of the solum ranges from 40 to 60 inches. The mollic epipedon is more than 24 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It is dominantly silt loam but in some pedons is silty clay loam. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 7.5YR, value of 2 to 4 (3 to 5 dry), and chroma of 2 to 4. It is medium acid or slightly acid. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5 (5 or 6 dry), and chroma of 2 to 4. It is silty clay loam or silty clay. It ranges from slightly acid to mildly alkaline.

Sogn series

The Sogn series consists of shallow and very shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in residuum of limestone (fig. 18). Slopes range from 0 to 20 percent.

Sogn soils are similar to Darnell soils and commonly are adjacent to Clime, Eram, and Labette soils. Darnell soils are more sandy throughout than the Sogn soils. The calcareous Clime soils and the moderately well drained Eram soils are 20 to 40 inches deep over shale. They generally are lower on the landscape than the Sogn soils. Labette soils are 20 to 40 inches deep over limestone. They generally are higher on the landscape than the Sogn soils.

Typical pedon of Sogn silty clay loam, in an area of Clime-Sogn complex, 5 to 20 percent slopes, 1,200 feet east and 50 feet south of the northwest corner of sec. 10, T. 24 S., R. 9 E.

A—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong fine granular structure; friable, slightly hard; many fine roots; some limestone fragments; mildly alkaline; abrupt wavy boundary.

R—7 inches; platy limestone that has a few crevices.

The thickness of the solum, or the depth to limestone, ranges from 4 to 20 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It ranges from slightly acid to moderately alkaline.

Steedman series

The Steedman series consists of moderately deep, moderately well drained, slowly permeable soils on uplands. These soils formed in material weathered from shale. Slopes range from 3 to 12 percent.

Steedman soils are similar to Eram and Niotaze soils and commonly are adjacent to Eram and Kenoma soils. Eram soils have a mollic epipedon. Niotaze soils have an E horizon and are more acid than the Steedman soils. Also, they generally are lower on the landscape. Kenoma soils are more than 40 inches deep over shale and have a mollic epipedon. They are on broad ridgetops above the Steedman soils.

Typical pedon of Steedman stony loam, 3 to 12 percent slopes (fig. 19), 400 feet west and 200 feet north of the southeast corner of sec. 20, T. 27 S., R. 13 E.

A—0 to 8 inches; very dark grayish brown (10YR 3/2) stony loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; very friable, slightly hard; many fine roots; about 10 percent sandstone fragments as much as 3 inches in size and a few as much as 6 inches in size; angular sandstone rocks more than 10 inches in size on less than 3 percent of the surface; strongly acid; clear wavy boundary.

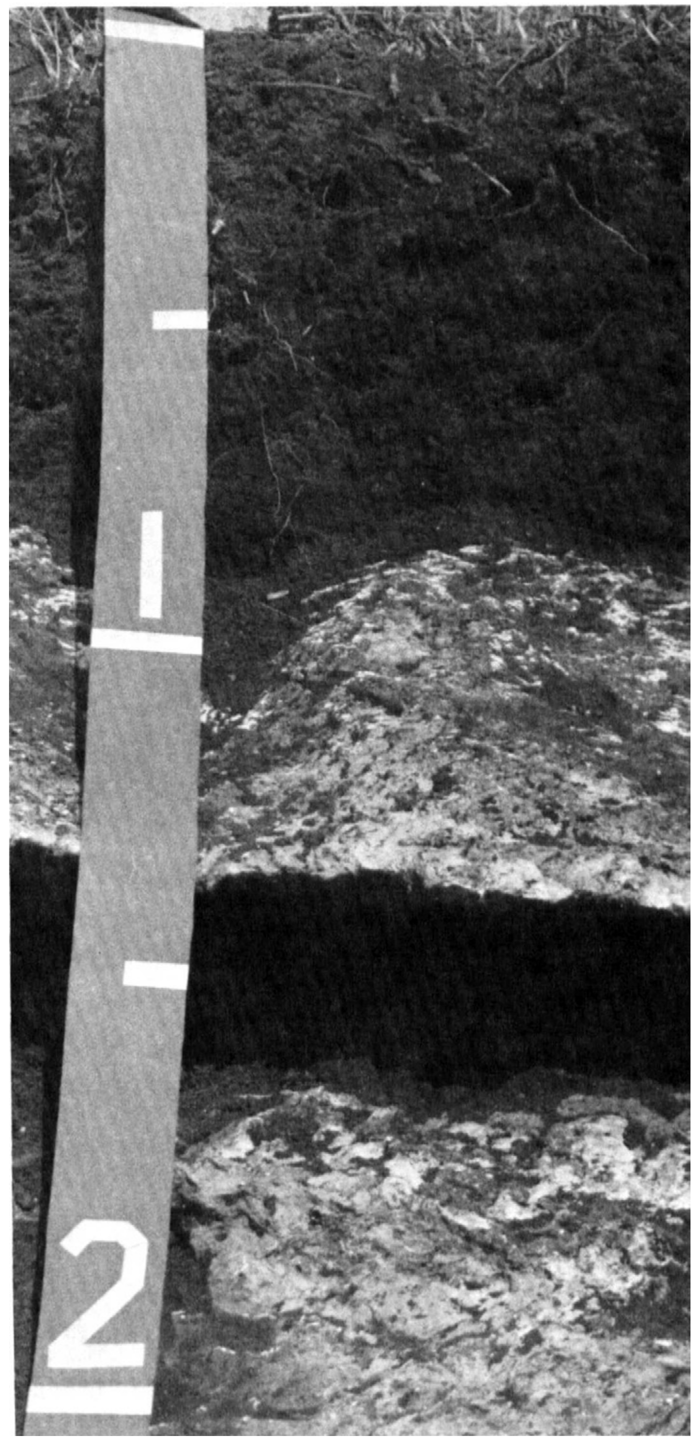

Figure 18.—Profile of Sogn silty clay loam. The depth to limestone is about 9 inches. Depth is marked in feet.

Figure 19.—Profile of Steedman stony loam. The arrow indicates the bottom of the stony surface layer. Depth is marked in feet.

Bt1—8 to 19 inches; reddish brown (5YR 4/4) silty clay, reddish brown (5YR 5/4) dry; common medium distinct brown (10YR 4/3) mottles; moderate fine subangular blocky structure; very firm, extremely hard; clay films on faces of peds; common fine roots; slightly acid; gradual smooth boundary.

Bt2—19 to 30 inches; dark yellowish brown (10YR 4/6) silty clay, yellowish brown (10YR 5/6) dry; many medium distinct dark gray (10YR 4/1) mottles; moderate fine subangular blocky structure; very firm, extremely hard; few fine roots; clay films on faces of peds; a few small fragments of weathered shale; slightly acid; gradual wavy boundary.

Cr—30 inches; clayey shale.

The thickness of the solum ranges from 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 to 3. It ranges from slightly acid to strongly acid. It is loam, silt loam, or the stony analogs of those textures. In this horizon the content of rock fragments more than 3 inches in size ranges from 0 to 50 percent. The Bt horizon has hue of 5YR to 10YR and value of 4 or 5 (5 or 6 dry). It has chroma of 2 to 4 in the upper part and chroma of 2 to 6 in the lower part. It is silty clay or clay. It ranges from slightly acid to moderately alkaline.

Woodson series

The Woodson series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in clayey sediments. Slopes range from 0 to 2 percent.

Woodson soils are similar to Dwight, Kenoma, Martin, and Zaar soils and commonly are adjacent to Kenoma and Martin soils. Dwight soils have a natric horizon. Kenoma soils are on ridgetops and generally are more sloping than the Woodson soils. Also, they have a browner subsoil. Martin soils have a BA horizon. They are on the lower side slopes. Zaar soils do not have an argillic horizon. Their surface layer is more clayey than that of the Woodson soils.

Typical pedon of Woodson silt loam, 0 to 2 percent slopes, 2,600 feet south and 50 feet west of the northeast corner of sec. 17, T. 25 S., R. 11 E.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable, very hard; many fine roots; slightly acid; clear smooth boundary.

Bt1—7 to 16 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; very firm, extremely hard; thin patchy clay films on faces of most peds; common fine roots; neutral; gradual smooth boundary.

Bt2—16 to 32 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine blocky structure; extremely firm, extremely hard; few fine roots; thick continuous clay films on faces of most peds; neutral; gradual smooth boundary.

BC—32 to 40 inches; dark grayish brown (2.5Y 4/2) clay, grayish brown (2.5Y 5/2) dry; few black (10YR 2/1) streaks; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine blocky structure; extremely firm, extremely hard; few lime concretions; thick continuous clay films on faces of most peds; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; grayish brown (10YR 5/2) silty clay loam, light brownish gray (10YR 6/2) dry; many medium dark yellowish brown (10YR 4/6) mottles; massive; extremely firm, extremely hard; few lime concretions and accumulations; mildly alkaline.

The thickness of the solum ranges from 30 to 55 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or less. It is dominantly silt loam but in some pedons is silty clay loam. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 6 dry), and chroma of 1. It is silty clay or clay. It ranges from medium acid to neutral.

Zaar series

The Zaar series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in clayey residuum of shale. Slopes range from 0 to 2 percent.

Zaar soils are similar to Martin, Osage, and Woodson soils and commonly are adjacent to Martin and Reading soils. The moderately well drained Martin soils generally are more sloping than the Zaar soils. They have an argillic horizon. The poorly drained Osage soils are on flood plains. The surface layer of Woodson soils is less clayey than that of the Zaar soils. The well drained Reading soils are on rarely flooded terraces. They are less clayey than the Zaar soils and have an argillic horizon.

Typical pedon of Zaar silty clay, 0 to 2 percent slopes, 2,050 feet north and 100 feet west of the southeast corner of sec. 34, T. 24 S., R. 9 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine granular structure in the upper 3 inches and moderate medium blocky structure in the lower 4 inches; very firm, extremely hard; common fine roots; slightly acid; clear smooth boundary.

A—7 to 13 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong fine granular structure; very firm, extremely hard; few fine roots; slightly acid; gradual smooth boundary.

Bw1—13 to 23 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine faint dark grayish brown (2.5Y 4/2) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; extremely firm, extremely hard; few fine roots; neutral; gradual smooth boundary.

Bw2—23 to 30 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; many fine distinct olive brown (2.5Y 4/4) mottles; few cracks filled with black (10YR 2/1) material; moderate fine subangular blocky structure; extremely firm, extremely hard; few fine roots; few black concretions; mildly alkaline; gradual smooth boundary.

Bw3—30 to 38 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; few fine faint dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; extremely firm, extremely hard; mildly alkaline; gradual smooth boundary.

BC—38 to 53 inches; mixed dark gray (10YR 4/1) and brown (10YR 4/3) silty clay, gray (10YR 5/1) and brown (10YR 5/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm, extremely hard; moderately alkaline; gradual smooth boundary.

C—53 to 60 inches; mixed dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) silty clay, grayish brown (10YR 5/2) and brownish yellow (10YR 6/6) dry; weak fine subangular blocky structure; very firm, extremely hard; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The depth to lime is more than 50 inches. All horizons are silty clay or clay.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is medium acid or slightly acid. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3 in the upper part and hue of 10YR or 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4 in the lower part. It is neutral or mildly alkaline. In some pedons it has slickensides.

formation of the soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of a soil at any given point are determined by the interaction of five factors of soil formation. These factors are the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the processes of soil formation have acted on the parent material. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The effects of the individual factors vary from place to place. The interaction among the factors is more complex for some soils than for others.

The paragraphs that follow describe the effects of the factors of soil formation on the soils in Greenwood County.

parent material

Parent material is the unconsolidated material in which soils form. It either is material weathered from rocks through freezing and thawing, abrasion, or chemical processes or is weathered material deposited by wind or water. It affects texture, structure, color, natural fertility, and many other soil properties. Soils differ partly because of the various kinds of parent material. The texture greatly affects soil formation through its effect on the rate at which water and air move downward through the soil. The composition of the parent material largely determines the mineralogical composition of the soil and thus its natural fertility.

The soils in Greenwood County generally formed in material weathered from limestone or shale. Most of those in the western third of the county formed in material weathered from Lower Permian rocks. Some of those in the eastern two-thirds formed in material weathered from Upper Pennsylvanian rocks. Other kinds of parent material in the county are residuum of sandstone, alluvial sediments, and eolian and colluvial sediments.

Clime, Dennis, Eram, Martin, Steedman, and Zaar soils formed in material weathered from shale. Sogn soils formed in material weathered from limestone, and Florence soils formed in residuum of cherty limestone. Darnell soils formed in material weathered from sandstone.

Alluvium is material deposited by streams. The alluvial soils in the county formed in either recent or old alluvium. The recent alluvium is in the stream valleys. Chase, Ivan, Osage, and Reading soils formed in this material. The old alluvium is on what are now the uplands. Olpe soils and some of the Kenoma soils formed in this material.

Some of the soils formed in material derived from more than one source. The lower part of the Niotaze soils, for example, formed in material weathered from shale, but in many areas the upper part apparently formed in material weathered from sandstone. The upper part of Kenoma, Newtonia, and Woodson soils is somewhat influenced by eolian sediments. In some areas Dennis and Martin soils formed in colluvium.

climate

Climate is an active factor of soil formation. It directly affects soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plant and animal life.

The climate of Greenwood County is continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. As a result of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils.

plant and animal life

Plants generally affect the content of nutrients and of organic matter in the soil and the color of the surface layer. Bacteria and fungi help to decompose the plants, thus releasing plant nutrients. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous.

The mid and tall prairie grasses have greatly affected soil formation in Greenwood County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. In many areas the next part is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light colored.

Some of the soils in the southern part of the county formed in areas forested with oak. These soils lack the thick, dark surface layer characteristic of the soils that formed under prairie grasses. Also, they are more acid.

relief

Relief affects soil formation through its effect on drainage, runoff, plant cover, and soil temperature. Most important is the effect that it has on the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper upland soils than on the less sloping soils. As a result, less water penetrates the surface and erosion is more extensive. Relief has retarded the formation of Clime soils, which formed in old parent material. Runoff is rapid on these moderately sloping to moderately steep soils. As a result, much of the soil material is removed as soon as the soil forms. In contrast, the nearly level and gently sloping soils in the county generally have distinct horizons.

time

The length of time that the soil material has been subject to the processes of soil formation commonly is reflected in the degree of profile development. Soils without distinct horizons are considered young, whereas those with distinct horizons are considered old or mature.

The soils in Greenwood County range from immature to mature. Ivan and other young soils are on bottom land that is subject to stream overflow. They receive new sediments with each flood. They have been in place long enough for the formation of a thick, dark surface layer, but little or no clay has moved downward through the profile. In contrast, the mature Kenoma and Woodson soils have very distinct horizons. Much of the clay has been translocated to the subsoil. Thousands of years were needed for the formation of these mature soils.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. l0, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Byers, W.C., N.S. Robb, and J.P. Stack. 1914. Soil survey of Greenwood County, Kansas. U.S. Dep. Agric., Bur. of Soils, 34 pp., illus.

(4) Kansas State Board of Agriculture. 1979. 1978-1979 farm facts. Spec. Rep. Kans. Crop & Kans. Cattle Mark. Stat., 96 pp., illus.

(5) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(7) United States Department of Agriculture. SCS resource inventories, Greenwood County, Kansas. Unpublished data, collected in 1979, available at local offices of the Soil Conserv. Serv.

glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedding. Draining the soil through a series of broad beds made by plowing, grading, or otherwise elevating the surface of a flat field.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.
Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.
Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.
Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon below an O or A horizon and above a B horizon. The E horizon is characterized by a loss of some combination of silicate clay, iron, and aluminum and by a remaining concentration of sand and silt particles of quartz or other resistant minerals.

B horizon.—The mineral horizon below an A, E, or O horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or angular or subangular blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A, E, and B horizons are generally called the solum. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A, E, or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

R layer.—Hard bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na! to Ca!! + Mg!!. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1954-76 at Eureka, Kansas]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	42.9	19.0	31.0	72	-8	1.09	0.35	1.79	3	4.3
February---	49.2	23.9	36.6	79	1	1.13	0.35	2.08	3	3.9
March------	59.0	31.8	45.4	86	4	2.51	1.12	3.39	5	4.0
April------	71.6	44.3	58.0	92	22	3.23	1.80	4.88	6	0.3
May--------	79.6	54.0	66.8	94	33	4.72	2.29	7.43	7	.0
June-------	86.5	62.1	74.3	99	46	5.66	2.66	8.33	8	.0
July-------	93.1	67.5	80.3	106	50	3.79	0.75	6.09	7	.0
August-----	92.3	65.4	78.9	107	49	3.54	1.20	5.69	5	.0
September--	83.1	57.2	70.2	100	36	5.31	1.65	9.03	6	.0
October----	73.5	45.9	59.7	93	24	3.17	0.68	4.62	4	0.1
November---	58.3	32.8	45.6	80	6	1.96	0.15	3.91	3	1.6
December---	46.9	24.0	35.5	72	-3	1.54	0.54	2.63	4	3.9
Year-----	69.7	44.0	56.8	107	-8	37.65	28.77	46.12	61	18.1

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 9	April 18	April 29
2 years in 10 later than--	April 4	April 13	April 24
5 years in 10 later than--	March 26	April 3	April 14
First freezing temperature in fall:			
1 year in 10 earlier than--	October 24	October 16	October 7
2 years in 10 earlier than--	October 28	October 21	October 11
5 years in 10 earlier than--	November 7	October 30	October 21

TABLE 3.--GROWING SEASON

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	205	189	169
8 years in 10	212	196	176
5 years in 10	226	210	190
2 years in 10	240	223	204
1 year in 10	247	230	212

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
At	Aquents, flooded	200	*
Ca	Chase silty clay loam	10,500	1.4
Ce	Clime stony silty clay loam, 20 to 30 percent slopes	10,400	1.4
Cm	Clime silty clay, 3 to 7 percent slopes	12,800	1.7
Cs	Clime-Sogn complex, 5 to 20 percent slopes	198,200	26.9
De	Dennis silt loam, 1 to 4 percent slopes	21,000	2.8
Dn	Dennis silt loam, 4 to 7 percent slopes	9,200	1.2
Ds	Dennis silty clay loam, 2 to 6 percent slopes, eroded	990	0.1
Dw	Dwight silt loam, 0 to 2 percent slopes	4,350	0.6
Eb	Eram silty clay loam, 1 to 4 percent slopes	21,250	2.9
Ec	Eram silty clay loam, 4 to 7 percent slopes	38,000	5.2
Eh	Eram silty clay loam, 3 to 7 percent slopes, eroded	1,950	0.3
Ft	Florence-Labette complex, 2 to 12 percent slopes	18,800	2.6
Ic	Ivan silt loam, channeled	15,100	2.1
If	Ivan silt loam, occasionally flooded	19,100	2.6
Ka	Kenoma silt loam, 1 to 4 percent slopes	57,500	7.8
Ke	Kenoma silty clay loam, 2 to 5 percent slopes, eroded	550	0.1
La	Labette silty clay loam, 1 to 4 percent slopes	32,500	4.4
Ld	Labette-Dwight complex, 0 to 3 percent slopes	31,500	4.3
Ls	Labette-Sogn silty clay loams, 0 to 8 percent slopes	43,400	5.9
Ma	Martin silty clay loam, 1 to 4 percent slopes	26,200	3.6
Mb	Martin silty clay loam, 4 to 7 percent slopes	18,800	2.6
Me	Martin silty clay, 3 to 7 percent slopes, eroded	1,400	0.2
Na	Newtonia silt loam, 0 to 2 percent slopes	730	0.1
Nd	Niotaze-Darnell complex, 0 to 6 percent slopes	2,200	0.3
Nz	Niotaze-Darnell complex, 6 to 35 percent slopes	3,800	0.5
Od	Oil wasteland	350	*
Op	Olpe gravelly silt loam, 4 to 15 percent slopes	8,850	1.2
Os	Osage silty clay	850	0.1
Pt	Pits, quarries	270	*
Re	Reading silt loam	36,180	5.0
St	Steedman stony loam, 3 to 12 percent slopes	47,300	6.4
Wo	Woodson silt loam, 0 to 2 percent slopes	35,500	4.8
Za	Zaar silty clay, 0 to 2 percent slopes	1,880	0.3
	Water (greater than 40 acres)	4,400	0.6
	Total	736,000	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Only arable soils are listed. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Grain sorghum	Winter wheat	Soybeans	Alfalfa hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Ca Chase	92	46	36	5.0	8.0
Cm Clime	46	30	18	1.6	4.5
De Dennis	75	41	35	4.5	6.0
Dn Dennis	70	38	30	3.5	6.0
Ds Dennis	60	33	20	3.5	5.0
Dw Dwight	40	27	---	1.5	3.5
Eb Eram	50	33	25	3.0	5.0
Ec Eram	45	29	18	2.5	4.5
Eh Eram	35	20	15	2.0	4.0
If Ivan	80	46	35	5.5	8.0
Ka Kenoma	70	39	28	3.2	5.0
Ke Kenoma	55	31	18	2.5	3.5
La Labette	62	39	25	3.0	5.0
Ld Labette-Dwight	50	33	20	2.5	4.3
Ma Martin	75	41	35	3.5	6.0
Mb Martin	70	38	30	3.2	5.5
Me Martin	60	33	23	2.6	5.0
Na Newtonia	80	46	35	4.5	7.0
Os Osage	60	30	25	2.5	6.5

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Grain sorghum	Winter wheat	Soybeans	Alfalfa hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Re------------------------ Reading	90	48	35	5.5	7.5
Wo------------------------ Woodson	72	36	28	3.3	5.0
Za------------------------ Zaar	68	36	28	3.3	5.5

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ca: Chase	Loamy Lowland	Favorable	10,000	Big bluestem	30
		Normal	8,500	Prairie cordgrass	15
		Unfavorable	6,000	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	10
Ce, Cm: Clime	Limy Upland	Favorable	5,000	Little bluestem	30
		Normal	3,500	Big bluestem	20
		Unfavorable	2,500	Sideoats grama	15
				Indiangrass	5
				Switchgrass	5
				Blue grama	5
Cs*:					
Clime	Limy Upland	Favorable	5,000	Little bluestem	30
		Normal	3,500	Big bluestem	25
		Unfavorable	2,500	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Blue grama	5
Sogn	Shallow Limy	Favorable	3,500	Sideoats grama	25
		Normal	2,500	Big bluestem	15
		Unfavorable	1,500	Little bluestem	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Blue grama	5
De, Dn, Ds: Dennis	Loamy Upland	Favorable	6,500	Big bluestem	35
		Normal	5,000	Switchgrass	15
		Unfavorable	4,000	Little bluestem	15
				Indiangrass	10
Dw: Dwight	Claypan	Favorable	4,000	Big bluestem	15
		Normal	3,000	Little bluestem	10
		Unfavorable	2,000	Tall dropseed	10
				Blue grama	10
				Western wheatgrass	10
				Switchgrass	10
				Sideoats grama	10
				Buffalograss	5
Eb, Ec, Eh: Eram	Clay Upland	Favorable	6,000	Big bluestem	30
		Normal	4,200	Little bluestem	15
		Unfavorable	3,000	Switchgrass	15
				Indiangrass	10
				Tall dropseed	5
Ft*:					
Florence	Loamy Upland	Favorable	5,000	Big bluestem	40
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	5
				Eastern gamagrass	5
				Tall dropseed	5
				Sideoats grama	5
Labette	Loamy Upland	Favorable	5,000	Big bluestem	40
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	5
				Eastern gamagrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ic, If: Ivan	Loamy Lowland	Favorable	10,000	Big bluestem	40
		Normal	8,000	Indiangrass	10
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
				Little bluestem	5
Ka, Ke: Kenoma	Clay Upland	Favorable	6,000	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	15
				Switchgrass	15
				Tall dropseed	5
La: Labette	Loamy Upland	Favorable	5,000	Big bluestem	40
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	5
				Eastern gamagrass	5
Ld*:					
Labette	Loamy Upland	Favorable	5,000	Big bluestem	40
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	5
				Eastern gamagrass	5
Dwight	Claypan	Favorable	4,000	Big bluestem	15
		Normal	3,000	Little bluestem	10
		Unfavorable	2,000	Tall dropseed	10
				Western wheatgrass	10
				Blue grama	5
				Switchgrass	5
				Sideoats grama	5
				Buffalograss	5
Ls*:					
Labette	Loamy Upland	Favorable	5,000	Big bluestem	40
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	5
				Eastern gamagrass	5
Sogn	Shallow Limy	Favorable	3,500	Sideoats grama	25
		Normal	2,500	Big bluestem	15
		Unfavorable	1,500	Little bluestem	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Blue grama	5
Ma, Mb, Me: Martin	Loamy Upland	Favorable	6,000	Big bluestem	40
		Normal	5,000	Little bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Tall dropseed	5
				Sideoats grama	5
Na: Newtonia	Loamy Upland	Favorable	6,500	Big bluestem	35
		Normal	5,500	Little bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	10
Nd*, Nz*:					
Niotaze	Savannah	Favorable	5,000	Little bluestem	25
		Normal	4,000	Big bluestem	20
		Unfavorable	3,000	Post oak	10
				Blackjack oak	10
				Indiangrass	10
				Switchgrass	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Nd*, Nz*:					
Darnell	Shallow Savannah	Favorable	3,200	Little bluestem	30
		Normal	2,100	Big bluestem	20
		Unfavorable	1,400	Blackjack oak	15
				Indiangrass	5
				Switchgrass	5
				Sideoats grama	5
				Post oak	5
Op: Olpe	Loamy Upland	Favorable	6,000	Big bluestem	40
		Normal	5,000	Little bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	5
				Sideoats grama	5
Os: Osage	Clay Lowland	Favorable	8,500	Prairie cordgrass	35
		Normal	7,000	Big bluestem	20
		Unfavorable	4,500	Switchgrass	15
				Indiangrass	10
				Eastern gamagrass	5
Re: Reading	Loamy Lowland	Favorable	9,000	Big bluestem	40
		Normal	7,000	Indiangrass	10
		Unfavorable	5,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
St: Steedman	Loamy Upland	Favorable	6,000	Big bluestem	40
		Normal	4,500	Little bluestem	25
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
Wo: Woodson	Clay Upland	Favorable	6,000	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
Za: Zaar	Clay Upland	Favorable	6,000	Big bluestem	35
		Normal	4,500	Little bluestem	25
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
Ca: Chase	3c	Slight	Moderate	Moderate	Slight	Bur oak	62	Bur oak, green ash, eastern cottonwood, hackberry, pecan, black walnut.
						Hackberry	60	
						Green ash	60	
						Eastern cottonwood	66	
						Black walnut	55	
Ic, If: Ivan	2o	Slight	Slight	Slight	Moderate	Black walnut	73	Black walnut, pecan, eastern cottonwood, green ash, hackberry, bur oak.
						Hackberry	74	
						Bur oak	50	
						Green ash	90	
						Silver maple	89	
Nd*, Nz*:								
Niotaze	5d	Moderate	Moderate	Slight	Slight	Post oak	30	Northern red oak.
						Blackjack oak	25	
						Northern red oak	---	
Darnell	5d	Slight	Moderate	Moderate	Slight	Post oak	30	Northern red oak, bur oak.
						Blackjack oak	30	
Os: Osage	4w	Slight	Moderate	Severe	Severe	Pin oak	70	Pin oak, pecan.
						Pecan	75	
						Eastern cottonwood	80	
						Bur oak	---	
Re: Reading	2o	Slight	Slight	Slight	Moderate	Black walnut	73	Black walnut, green ash, hackberry, bur oak, eastern cottonwood, northern red oak, pecan.
						Hackberry	69	
						Bur oak	60	
						Shagbark hickory	62	
						Northern red oak	---	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
At*. Aquents					
Ca----------------- Chase	---	American plum, Amur honeysuckle, Peking cotoneaster, lilac.	Eastern redcedar	Austrian pine, eastern white pine, bur oak, green ash, hackberry, honeylocust.	Eastern cottonwood.
Ce, Cm------------ Clime	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Cs*:					
Clime------------	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Sogn.					
De, Dn, Ds-------- Dennis	American plum, fragrant sumac, Peking cotoneaster, lilac.	---	Flowering dogwood, Russian mulberry, hackberry, eastern redcedar, green ash.	Honeylocust, Austrian pine, Scotch pine.	---
Dw----------------- Dwight	Silver buffaloberry.	Russian-olive, osageorange.	Eastern redcedar, Siberian elm.	---	---
Eb, Ec, Eh-------- Eram	Lilac, American plum, common chokecherry, fragrant sumac.	Autumn-olive------	Eastern redcedar, pin oak, hackberry, Russian-olive.	Green ash, honeylocust, Austrian pine.	---
Ft*:					
Florence---------	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, hackberry, bur oak, Austrian pine, green ash, Russian-olive.	Honeylocust, Siberian elm.	---
Labette----------	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Russian-olive, eastern redcedar, hackberry, green ash, Austrian pine.	Siberian elm, honeylocust.	---
Ic, If------------ Ivan	Blackhaw----------	Siberian peashrub, Tatarian honeysuckle.	Russian-olive, Washington hawthorn, eastern redcedar.	Honeylocust, green ash, hackberry, bur oak.	Siberian elm, eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Ka, Ke: Kenoma	Peking cotoneaster, lilac, fragrant sumac.	Amur honeysuckle, Manchurian crabapple.	Green ash, hackberry, Austrian pine, Russian-olive, eastern redcedar.	Siberian elm, honeylocust.	---
La: Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Russian-olive, eastern redcedar, hackberry, green ash, Austrian pine.	Siberian elm, honeylocust.	---
Ld*:					
Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Russian-olive, eastern redcedar, hackberry, green ash, Austrian pine.	Siberian elm, honeylocust.	---
Dwight	Silver buffaloberry.	Russian-olive, osageorange.	Eastern redcedar, Siberian elm.	---	---
Ls*:					
Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Russian-olive, eastern redcedar, hackberry, green ash, Austrian pine.	Siberian elm, honeylocust.	---
Sogn.					
Ma, Mb, Me: Martin	Peking cotoneaster, lilac.	Amur maple, Manchurian crabapple, autumn-olive.	Green ash, hackberry, Austrian pine, eastern redcedar, Russian-olive, jack pine.	Honeylocust	---
Na: Newtonia	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, Russian-olive.	Norway spruce, eastern white pine, honeylocust, green ash, pin oak.	---
Nd*:					
Niotaze	Lilac, Peking cotoneaster.	Amur honeysuckle, Siberian peashrub.	Hackberry, green ash, eastern redcedar, Russian-olive.	Austrian pine, honeylocust, Siberian elm.	---
Darnell.					
Nz*:					
Niotaze	Amur honeysuckle, lilac, Peking cotoneaster, fragrant sumac.	---	Austrian pine, eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Honeylocust, Siberian elm.	---
Darnell.					
Od*. Oil wasteland					
Op: Olpe	Fragrant sumac, Peking cotoneaster, Amur honeysuckle, lilac.	Russian-olive	Bur oak, eastern redcedar, hackberry, Austrian pine, green ash.	Siberian elm, honeylocust.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Os: Osage	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, honeylocust, green ash, golden willow.	Eastern cottonwood.
Pt*. Pits					
Re: Reading	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, bur oak, green ash, Russian-olive, hackberry.	Austrian pine, honeylocust, Scotch pine.	---
St: Steedman	Lilac	Austrian pine, Amur honeysuckle, euonymus, redbud.	Eastern redcedar, hackberry, honeylocust, bur oak, osageorange, Russian-olive.	Siberian elm	---
Wo: Woodson	Peking cotoneaster, lilac, fragrant sumac.	Manchurian crabapple, Amur honeysuckle.	Green ash, hackberry, eastern redcedar, Russian-olive.	Austrian pine, honeylocust, Siberian elm.	---
Za: Zaar	Peking cotoneaster, lilac, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, Manchurian crabapple.	Austrian pine, Russian-olive, hackberry, green ash, honeylocust.	Siberian elm	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
At*. Aquents				
Ca. Chase	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, flooding, percs slowly.	Severe: erodes easily.
Ce. Clime	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Cm. Clime	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
Cs*:				
Clime	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
De, Dn, Ds. Dennis	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.
Dw. Dwight	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
Eb, Ec, Eh. Eram	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Severe: erodes easily.
Ft*:				
Florence	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
Labette	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Ic. Ivan	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
If. Ivan	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ka, Ke. Kenoma	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight.
La. Labette	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Ld*:				
Labette	Slight	Slight	Moderate: small stones.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ld*:				
Dwight	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
Ls*:				
Labette	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Ma, Mb Martin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Severe: erodes easily.
Me Martin	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey, erodes easily.
Na Newtonia	Slight	Slight	Slight	Severe: erodes easily.
Nd*:				
Niotaze	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Severe: erodes easily.
Darnell	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Nz*:				
Niotaze	Severe: slope, wetness.	Severe: slope.	Severe: slope, wetness.	Severe: erodes easily.
Darnell	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Od*. Oil wasteland				
Op Olpe	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Slight.
Os Osage	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.
Pt*. Pits				
Re Reading	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
St Steedman	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Wo Woodson	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Za-------------------- Zaar	Severe: wetness, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
At*. Aquents												
Ca Chase	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	Good.
Ce, Cm Clime	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Cs*:												
Clime	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Sogn	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
De Dennis	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Dn, Ds Dennis	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Dw Dwight	Fair	Fair	Fair	---	---	Fair	Poor	Fair	Fair	---	Poor	Fair.
Eb Eram	Fair	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Ec, Eh Eram	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Ft*:												
Florence	Poor	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Labette	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Ic Ivan	Poor	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor	Good.
If Ivan	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	Good.
Ka, Ke Kenoma	Good	Good	Fair	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
La Labette	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Ld*:												
Labette	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Dwight	Fair	Fair	Fair	---	---	Fair	Poor	Fair	Fair	---	Poor	Fair.
Ls*:												
Labette	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Sogn	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Ma Martin	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Mb, Me------------- Martin	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Na----------------- Newtonia	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Nd*:												
Niotaze-----------	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Fair.
Darnell-----------	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Nz*:												
Niotaze-----------	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Darnell-----------	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Od*. Oil wasteland												
Op----------------- Olpe	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	Fair.
Os----------------- Osage	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	---
Pt*. Pits												
Re----------------- Reading	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
St----------------- Steedman	Fair	Good	Fair	Poor	Fair	Fair	Poor	Very poor.	Fair	Poor	Very poor.	Fair.
Wo----------------- Woodson	Good	Good	Fair	Poor	Poor	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Za----------------- Zaar	Fair	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
At*. Aquents					
Ca----------------- Chase	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding.
Ce----------------- Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Cm----------------- Clime	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cs*: Clime------------	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Sogn-------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
De, Dn, Ds--------- Dennis	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Dw----------------- Dwight	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Eb, Ec, Eh--------- Eram	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ft*: Florence----------	Moderate: depth to rock, too clayey, large stones.	Moderate: shrink-swell, large stones.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope, large stones.	Severe: low strength.
Labette----------	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ic, If------------ Ivan	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Ka, Ke------------ Kenoma	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
La----------------- Labette	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ld*: Labette----------	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ld*:					
Dwight	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ls*:					
Labette	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Ma, Mb, Me Martin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Na Newtonia	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Nd*:					
Niotaze	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
Darnell	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Nz*:					
Niotaze	Severe: wetness, slope.	Severe: wetness, shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
Darnell	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Od*. Oil wasteland					
Op Olpe	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, shrink-swell.
Os Osage	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.
Pt*. Pits					
Re Reading	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
St Steedman	Severe: wetness, too clayey.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
Wo Woodson	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength, wetness.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Za----------------- Zaar	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
At*. Aquents					
Ca Chase	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Ce Clime	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Cm Clime	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Cs*:					
Clime	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Sogn	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
De, Dn, Ds Dennis	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Dw Dwight	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey, excess sodium.	Moderate: depth to rock.	Poor: too clayey, hard to pack, excess sodium.
Eb, Ec, Eh Eram	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Ft*:					
Florence	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack, small stones.
Labette	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Ic, If Ivan	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Ka, Ke Kenoma	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
La------------------ Labette	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Ld*:					
Labette------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Dwight-------------	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey, excess sodium.	Moderate: depth to rock.	Poor: too clayey, hard to pack, excess sodium.
Ls*:					
Labette------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Sogn---------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Ma, Mb, Me---------- Martin	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Na------------------ Newtonia	Moderate: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Fair: too clayey.
Nd*:					
Niotaze------------	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
Darnell------------	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Nz*:					
Niotaze------------	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, wetness, slope.	Severe: depth to rock, wetness, slope.	Poor: area reclaim, too clayey, hard to pack.
Darnell------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Od*. Oil wasteland					
Op------------------ Olpe	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, small stones.
Os------------------ Osage	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Pt*. Pits					

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Re: Reading	Severe: percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey, thin layer.
St: Steedman	Severe: percs slowly, wetness, depth to rock.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey.
Wo: Woodson	Severe: percs slowly, wetness.	Slight	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
Za: Zaar	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
At*. Aquents				
Ca-------- Chase	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ce-------- Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Cm-------- Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cs*:				
Clime--------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Sogn--------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
De, Dn, Ds-------- Dennis	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer.
Dw-------- Dwight	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Eb, Ec, Eh-------- Eram	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ft*:				
Florence--------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Labette--------	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ic, If-------- Ivan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ka, Ke-------- Kenoma	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
La-------- Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ld*:				
Labette--------	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ld*:				
Dwight	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Ls*:				
Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Ma, Mb Martin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Me Martin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Na Newtonia	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Nd*:				
Niotaze	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Darnell	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Nz*:				
Niotaze	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Darnell	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Od*. Oil wasteland				
Op Olpe	Fair: shrink-swell.	Improbable: excess fines.	Probable	Poor: small stones, area reclaim.
Os Osage	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Pt*. Pits				
Re Reading	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
St Steedman	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Wo-------------------- Woodson	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Za-------------------- Zaar	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
At*. Aquents						
Ca Chase	Slight	Severe: hard to pack.	Percs slowly, flooding, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
Ce Clime	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Slope, depth to rock, percs slowly.	Slope, depth to rock, percs slowly.
Cm Clime	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Cs*: Clime	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Slope, depth to rock, percs slowly.	Slope, depth to rock, percs slowly.
Sogn	Severe: depth to rock, slope.	Slight	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
De Dennis	Slight	Moderate: hard to pack, wetness.	Percs slowly	Wetness, percs slowly, rooting depth.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
Dn, Ds Dennis	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
Dw Dwight	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Percs slowly, erodes easily, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Eb Eram	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock.	Wetness, percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Ec, Eh Eram	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock, slope.	Wetness, percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Ft*: Florence	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Large stones, droughty, slope.	Large stones	Large stones, droughty.
Labette	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Ic, If Ivan	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Ka Kenoma	Slight	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Ke Kenoma	Moderate: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
La----------------- Labette	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Ld*:						
Labette----------	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Dwight-----------	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Percs slowly, erodes easily, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Ls*:						
Labette----------	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Sogn-------------	Severe: depth to rock.	Slight---------	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Ma----------------- Martin	Slight---------	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Mb----------------- Martin	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Me----------------- Martin	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, slow intake, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Na----------------- Newtonia	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Nd*:						
Niotaze----------	Moderate: depth to rock, slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Wetness, percs slowly.	Depth to rock, erodes easily.	Wetness, erodes easily.
Darnell----------	Severe: depth to rock.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Nz*:						
Niotaze----------	Severe: slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Wetness, percs slowly.	Slope, depth to rock, erodes easily.	Wetness, slope, erodes easily.
Darnell----------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Od*. Oil wasteland						
Op----------------- Olpe	Severe: slope.	Slight---------	Deep to water	Percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.
Os----------------- Osage	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
Pt*. Pits						
Re----------------- Reading	Moderate: seepage.	Slight---------	Deep to water	Favorable------	Erodes easily	Erodes easily.
St----------------- Steedman	Moderate: slope, depth to rock.	Severe: shrink-swell.	Percs slowly---	Slow intake, slope.	Percs slowly---	Percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Wo----------------- Woodson	Slight----------	Severe: wetness.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Percs slowly, wetness, erodes easily.
Za----------------- Zaar	Slight----------	Moderate: hard to pack, wetness.	Percs slowly---	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
At*. Aquents											
Ca------- Chase	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
	14-45	Silty clay, silty clay loam, clay.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-65	20-45
	45-60	Silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-60	20-40
Ce------- Clime	0-9	Silty clay loam	CL	A-7, A-6	0-15	90-100	90-100	85-100	80-95	35-50	15-25
	9-18	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	80-100	70-95	35-60	15-35
	18-30	Silty clay, clay	CL, CH	A-7	0	85-100	80-100	75-95	60-90	45-60	20-30
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cm------- Clime	0-11	Silty clay-------	CL, CH	A-7	0-15	90-100	90-100	85-100	80-95	40-60	15-35
	11-20	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	80-100	70-95	35-60	15-35
	20-32	Silty clay, clay	CL, CH	A-7	0	85-100	80-100	75-95	60-90	45-60	20-30
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cs*:											
Clime-------	0-11	Silty clay-------	CL, CH	A-7	0-15	90-100	90-100	85-100	80-95	40-60	15-35
	11-23	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	80-100	70-95	35-60	15-35
	23-33	Silty clay, clay	CL, CH	A-7	0	85-100	80-100	75-95	60-90	45-60	20-30
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn-------	0-7	Silty clay loam	CL, MH, CH	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	7	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
De, Dn------- Dennis	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	20-37	1-15
	12-17	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	17-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Ds------- Dennis	0-6	Silty clay loam	CL	A-6, A-7	0	100	98-100	94-100	75-98	33-48	13-25
	6-16	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	16-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Dw------- Dwight	0-4	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	4-23	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	23-44	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-40
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Eb, Ec------- Eram	0-10	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	75-95	33-48	12-25
	10-33	Silty clay loam, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	33	Weathered bedrock	---	---	---	---	---	---	---	---	---
Eh------- Eram	0-6	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	75-95	33-48	12-25
	6-21	Silty clay loam, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	21	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ft*:											
Florence	0-13	Cherty silt loam	GC, SC, CL	A-6, A-2-6	0-10	30-90	20-75	20-75	20-70	25-35	10-20
	13-19	Very cherty silty clay loam, cherty silty clay loam.	GC, SC	A-2-7, A-7	10-20	30-70	20-45	20-45	15-40	50-65	30-40
	19-45	Very cherty silty clay, cherty clay, very cherty clay.	GC, SC, CH	A-2-7, A-7	10-40	30-90	20-80	20-75	15-70	50-75	30-45
	45	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Labette	0-9	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-31	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ic: Ivan	0-27	Silt loam	CL	A-4, A-6	0	95-100	95-100	90-100	70-100	25-40	7-20
	27-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-100	25-45	7-25
If: Ivan	0-38	Silt loam	CL	A-4, A-6	0	95-100	95-100	90-100	70-100	25-40	7-20
	38-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-100	25-45	7-25
Ka: Kenoma	0-11	Silt loam	CL, CL-ML, ML	A-4, A-6	0	85-100	85-100	85-100	85-100	25-40	3-18
	11-26	Silty clay, clay	CH	A-7	0	85-100	85-100	85-100	85-100	50-75	30-48
	26-60	Silty clay, silty clay loam.	CL, CH	A-7	0	85-100	85-100	75-100	75-95	45-65	25-44
Ke: Kenoma	0-4	Silty clay loam	CL	A-6	0	85-100	85-100	85-100	85-100	30-40	10-20
	4-25	Silty clay, clay	CH	A-7	0	85-100	85-100	85-100	85-100	50-75	30-48
	25-60	Silty clay, silty clay loam.	CL, CH	A-7	0	85-100	85-100	75-100	75-95	45-65	25-44
La: Labette	0-9	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-31	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ld*:											
Labette	0-9	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-36	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Dwight	0-4	Silt loam	CL-ML, CL, ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	4-23	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	23-44	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-40
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ls*:											
Labette	0-9	Silty clay loam	CL	A-6, A-7	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-26	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn	0-15	Silty clay loam	CL, MH, CH	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ma, Mb Martin	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-99	35-50	15-25
	11-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-98	41-70	25-40
Me Martin	0-7	Silty clay	CL	A-6, A-7	0	100	100	95-100	80-99	35-50	15-25
	7-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-98	41-70	25-40
Na Newtonia	0-12	Silt loam	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	9-14
	12-18	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	96-100	80-98	30-40	9-16
	18-26	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	90-98	33-42	12-19
	26-45	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	100	100	96-100	90-98	37-60	15-34
	45-60	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	75-100	75-100	70-98	70-98	37-60	15-34
Nd*, Nz*:											
Niotaze	0-9	Loam	SM-SC, CL, SC, CL-ML	A-4, A-6	0-25	75-100	75-100	65-95	35-95	20-40	5-15
	9-27	Silty clay, silty clay loam, clay.	CH, CL, ML	A-7-6, A-6	0	95-100	95-100	90-100	90-100	35-65	15-40
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell	0-6	Fine sandy loam	SM, SC, ML, CL	A-4	0-5	90-100	90-100	85-100	36-60	<30	NP-10
	6-16	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0-8	70-100	70-100	60-100	36-60	<30	NP-10
	16	Weathered bedrock	---	---	---	---	---	---	---	---	---
Od*. Oil wasteland											
Op Olpe	0-13	Gravelly silt loam.	GC, SC	A-2, A-4, A-6	0	30-75	30-75	20-55	15-50	20-40	7-20
	13-19	Very gravelly silty clay loam, very gravelly silty clay.	GC, SC, GP-GC, SP-SC	A-2, A-6, A-7	0	30-65	10-50	10-50	10-45	30-50	11-22
	19-50	Very gravelly silty clay, very gravelly clay.	GC, SC, GP-GC, SP-SC	A-2-7, A-7	0	30-65	10-50	10-50	10-45	40-65	25-40
	50-60	Gravelly clay, gravelly silty clay.	GC, SC, GP-GC, SP-SC	A-2, A-7	0	30-80	10-75	10-75	10-70	40-65	25-40
Os Osage	0-14	Silty clay	CH	A-7	0	100	100	100	95-100	50-75	30-55
	14-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	100	95-100	40-80	20-50
Pt*. Pits											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Re----------------- Reading	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	5-20
	13-44	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	44-60	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	80-100	35-50	15-30
St----------------- Steedman	0-8	Stony loam-------	CL	A-4, A-6	1-15	75-100	75-100	70-100	60-98	30-37	8-14
	8-30	Clay, silty clay	CL, CH	A-7	0	98-100	95-100	95-100	90-99	41-70	20-40
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wo----------------- Woodson	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	5-20
	7-32	Silty clay, clay	CH	A-7-6	0	100	95-100	95-100	90-100	50-65	30-45
	32-60	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	0	100	95-100	95-100	90-100	45-65	20-40
Za----------------- Zaar	0-13	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	13-53	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	53-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	90-100	40-65	15-40

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
At*. Aquents												
Ca---------------- Chase	0-14	27-35	1.30-1.45	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.37	5	7	2-4
	14-45	35-55	1.35-1.45	0.06-0.2	0.11-0.19	5.6-7.8	<2	High------	0.28			
	45-60	27-50	1.35-1.45	0.06-0.2	0.11-0.18	6.1-8.4	<2	High------	0.28			
Ce---------------- Clime	0-9	32-40	1.35-1.45	0.2-0.6	0.21-0.23	7.4-8.4	<2	Moderate	0.28	3	4L	2-4
	9-18	35-50	1.35-1.50	0.06-0.6	0.12-0.18	7.9-8.4	<2	Moderate	0.28			
	18-30	40-50	1.40-1.50	0.06-0.2	0.10-0.15	7.9-8.4	<2	Moderate	0.28			
	30	---	---	---	---	---	---	----------	----			
Cm---------------- Clime	0-11	40-50	1.35-1.45	0.06-0.2	0.12-0.14	7.4-8.4	<2	Moderate	0.28	3	4	1-4
	11-20	35-50	1.35-1.50	0.06-0.6	0.12-0.18	7.9-8.4	<2	Moderate	0.28			
	20-32	40-50	1.40-1.50	0.06-0.2	0.10-0.15	7.9-8.4	<2	Moderate	0.28			
	32	---	---	---	---	---	---	----------	----			
Cs*:												
Clime-----------	0-11	40-50	1.35-1.45	0.06-0.2	0.12-0.14	7.4-8.4	<2	Moderate	0.28	3	4	1-4
	11-23	35-50	1.35-1.50	0.06-0.6	0.12-0.18	7.9-8.4	<2	Moderate	0.28			
	23-33	40-50	1.40-1.50	0.06-0.2	0.10-0.15	7.9-8.4	<2	Moderate	0.28			
	33	---	---	---	---	---	---	----------	----			
Sogn------------	0-7	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	7	---	---	---	---	---	---	----------	----			
De, Dn----------- Dennis	0-12	10-27	1.30-1.55	0.6-2.0	0.15-0.20	5.1-6.0	<2	Low-------	0.37	4	---	1-3
	12-17	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	<2	Moderate	0.37			
	17-60	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	<2	High------	0.37			
Ds---------------- Dennis	0-6	27-35	1.30-1.60	0.2-0.6	0.15-0.20	5.6-7.3	<2	Moderate	0.37	4	---	1-3
	6-16	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	<2	Moderate	0.37			
	16-60	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	<2	High------	0.37			
Dw---------------- Dwight	0-4	18-30	1.20-1.35	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low-------	0.43	3	6	---
	4-23	45-60	1.30-1.40	<0.06	0.10-0.14	6.1-8.4	<4	High------	0.32			
	23-44	35-50	1.30-1.40	0.06-0.2	0.10-0.15	6.6-8.4	<8	High------	0.32			
	44	---	---	---	---	---	---	----------	----			
Eb, Ec----------- Eram	0-10	27-32	1.30-1.60	0.2-0.6	0.15-0.19	5.6-6.5	<2	Moderate	0.37	3	7	1-3
	10-33	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	<2	High------	0.37			
	33	---	---	---	---	---	---	----------	----			
Eh---------------- Eram	0-6	27-32	1.30-1.60	0.2-0.6	0.15-0.19	5.6-6.5	<2	Moderate	0.37	3	7	1-3
	6-21	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	<2	High------	0.37			
	21	---	---	---	---	---	---	----------	----			
Ft*:												
Florence--------	0-13	24-35	1.25-1.35	0.6-2.0	0.05-0.20	5.6-7.3	<2	Low-------	0.24	3	8	2-4
	13-19	35-55	1.35-1.55	0.2-0.6	0.03-0.11	5.6-7.3	<2	Moderate	0.24			
	19-45	50-80	1.35-1.60	0.2-0.6	0.03-0.12	6.1-7.8	<2	Moderate	0.24			
	45	---	---	---	---	---	---	----------	----			
Labette---------	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-31	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High------	0.37			
	31	---	---	---	---	---	---	----------	----			
Ic---------------- Ivan	0-27	16-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
	27-60	18-35	1.35-1.55	0.6-2.0	0.19-0.22	7.9-8.4	<2	Moderate	0.32			
If---------------- Ivan	0-38	16-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
	38-60	18-35	1.35-1.55	0.6-2.0	0.19-0.22	7.9-8.4	<2	Moderate	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Ka-------------- Kenoma	0-11	18-27	1.35-1.45	0.2-0.6	0.22-0.24	5.1-6.5	<2	Low--------	0.43	4	6	2-4
	11-26	40-60	1.40-1.50	<0.06	0.10-0.15	5.1-7.8	<2	High-------	0.32			
	26-60	30-50	1.35-1.45	0.06-0.2	0.18-0.20	6.1-8.4	<4	High-------	0.32			
Ke-------------- Kenoma	0-4	27-35	1.35-1.45	0.2-0.6	0.21-0.23	5.1-6.5	<2	Moderate	0.43	4	6	1-2
	4-25	40-60	1.40-1.50	<0.06	0.10-0.15	5.1-7.8	<2	High-------	0.32			
	25-60	30-50	1.35-1.45	0.06-0.2	0.18-0.20	6.1-8.4	<4	High-------	0.32			
La-------------- Labette	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-31	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High-------	0.37			
	31	---	---	---	---	---	---	-----------	----			
Ld*:												
Labette---------	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-36	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High-------	0.37			
	36	---	---	---	---	---	---	-----------	----			
Dwight----------	0-4	18-30	1.20-1.35	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low--------	0.43	3	6	---
	4-23	45-60	1.30-1.40	<0.06	0.10-0.14	6.1-8.4	<4	High-------	0.32			
	23-44	35-50	1.30-1.40	0.06-0.2	0.10-0.15	6.6-8.4	<8	High-------	0.32			
	44	---	---	---	---	---	---	-----------	----			
Ls*:												
Labette---------	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-26	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High-------	0.37			
	26	---	---	---	---	---	---	-----------	----			
Sogn------------	0-15	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	15	---	---	---	---	---	---	-----------	----			
Ma, Mb---------- Martin	0-11	27-42	1.35-1.40	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	7	2-4
	11-60	40-55	1.40-1.50	0.06-0.2	0.12-0.18	5.6-7.8	<2	High-------	0.37			
Me-------------- Martin	0-7	27-42	1.35-1.40	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	7	1-2
	7-60	40-55	1.40-1.50	0.06-0.2	0.12-0.18	5.6-7.8	<2	High-------	0.37			
Na-------------- Newtonia	0-12	10-24	1.30-1.55	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low--------	0.37	5	---	1-3
	12-18	20-35	1.40-1.70	0.6-2.0	0.16-0.22	5.1-6.5	<2	Moderate	0.37			
	18-26	27-35	1.45-1.70	0.6-2.0	0.18-0.22	5.1-6.0	<2	Moderate	0.32			
	26-45	32-45	1.35-1.65	0.6-2.0	0.12-0.20	5.1-6.0	<2	Moderate	0.32			
	45-60	32-45	1.35-1.65	0.6-2.0	0.12-0.20	5.1-7.3	<2	Moderate	0.32			
Nd*, Nz*:												
Niotaze---------	0-9	10-27	1.30-1.40	0.6-6.0	0.16-0.24	5.1-6.0	<2	Low--------	0.37	3	5	---
	9-27	35-55	1.35-1.45	0.06-0.2	0.10-0.18	4.5-7.3	<2	High-------	0.32			
	27	---	---	---	---	---	---	-----------	----			
Darnell---------	0-6	10-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low--------	0.24	2	---	<1
	6-16	10-25	1.40-1.70	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low--------	0.32			
	16	---	---	---	---	---	---	-----------	----			
Od*. Oil wasteland												
Op-------------- Olpe	0-13	15-30	1.20-1.30	0.6-2.0	0.06-0.18	5.1-6.5	<2	Low--------	0.24	3	8	---
	13-19	27-45	1.30-1.40	0.2-0.6	0.04-0.12	5.1-6.5	<2	Low--------	0.24			
	19-50	35-50	1.35-1.45	0.06-0.2	0.02-0.12	5.6-7.8	<2	Moderate	0.24			
	50-60	35-50	1.35-1.45	0.06-0.2	0.02-0.12	5.6-7.8	<2	Moderate	0.24			
Os-------------- Osage	0-14	40-50	1.40-1.60	<0.06	0.12-0.14	5.1-7.8	<2	Very high	0.28	5	4	1-4
	14-60	35-60	1.50-1.70	<0.06	0.08-0.12	5.6-7.8	<2	Very high	0.28			
Pt*. Pits												
Re-------------- Reading	0-13	18-27	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low--------	0.32	5	6	2-4
	13-44	27-35	1.40-1.50	0.2-2.0	0.18-0.20	5.6-7.3	<2	Moderate	0.43			
	44-60	30-42	1.40-1.50	0.2-2.0	0.13-0.20	6.1-8.4	<2	Moderate	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
St------------- Steedman	0-8	18-27	1.30-1.50	0.6-2.0	0.12-0.22	5.1-6.5	<2	Low--------	0.37	3	6	.5-1
	8-30	40-55	---	0.06-0.2	0.12-0.18	5.6-8.4	<2	High------	0.32			
	30	---	---	---	---	---	---	----------	----			
Wo------------- Woodson	0-7	18-27	1.25-1.45	0.2-0.6	0.22-0.24	5.6-6.5	<2	Low--------	0.43	4	6	1-4
	7-32	40-60	1.30-1.45	<0.06	0.12-0.15	5.6-7.3	<2	High------	0.32			
	32-60	30-50	1.35-1.45	0.06-0.2	0.10-0.15	5.6-7.8	<2	High------	0.32			
Za------------- Zaar	0-13	40-60	1.20-1.30	<0.06	0.12-0.14	5.6-7.3	<2	High------	0.28	5	4	2-4
	13-53	40-60	1.35-1.50	<0.06	0.11-0.18	6.1-8.4	<2	High------	0.28			
	53-60	35-50	1.35-1.50	<0.06	0.10-0.18	6.6-8.4	<2	High------	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
At*. Aquents											
Ca: Chase	C	Occasional	Very brief	Mar-Sep	2.0-4.0	Perched	Feb-May	>60	---	High	Low.
Ce, Cm: Clime	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
Cs*:											
Clime	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
Sogn	D	None	---	---	>6.0	---	---	4-20	Hard	Low	Low.
De, Dn, Ds: Dennis	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High	Moderate.
Dw: Dwight	D	None	---	---	>6.0	---	---	40-60	Hard	High	Moderate.
Eb, Ec, Eh: Eram	C	None	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Soft	High	Moderate.
Ft*:											
Florence	C	None	---	---	>6.0	---	---	40-60	Hard	Moderate	Low.
Labette	C	None	---	---	>6.0	---	---	20-40	Hard	High	Low.
Ic: Ivan	B	Frequent	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low	Low.
If: Ivan	B	Occasional	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low	Low.
Ka, Ke: Kenoma	D	None	---	---	>6.0	---	---	>60	---	High	Moderate.
La: Labette	C	None	---	---	>6.0	---	---	20-40	Hard	High	Low.
Ld*:											
Labette	C	None	---	---	>6.0	---	---	20-40	Hard	High	Low.
Dwight	D	None	---	---	>6.0	---	---	40-60	Hard	High	Moderate.
Ls*:											
Labette	C	None	---	---	>6.0	---	---	20-40	Hard	High	Low.
Sogn	D	None	---	---	>6.0	---	---	4-20	Hard	Low	Low.
Ma, Mb, Me: Martin	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High	Low.
Na: Newtonia	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Nd*, Nz*:											
Niotaze	C	None	---	---	1.0-2.0	Perched	Nov-Jun	20-40	Soft	High	Moderate.
Darnell	C	None	---	---	>6.0	---	---	10-20	Soft	Low	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
Od*. Oil wasteland											
Op----------------- Olpe	C	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate.
Os----------------- Osage	D	Occasional	Very brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	Moderate.
Pt*. Pits											
Re----------------- Reading	C	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
St----------------- Steedman	D	None---------	---	---	0.5-1.0	Perched	Nov-Mar	20-40	Soft	High-----	Moderate.
Wo----------------- Woodson	D	None---------	---	---	0.5-2.0	Perched	Dec-Apr	>60	---	High-----	Moderate.
Za----------------- Zaar	D	None---------	---	---	1.0-2.0	Perched	Dec-Apr	>60	---	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification: AASHTO	Classification: Unified	Percentage passing sieve--: No. 4	No. 10	No. 40	No. 200	Percentage smaller than--: .02 mm	.005 mm	.002 mm	Liquid limit	Plasticity index	Moisture density: Max. dry density	Moisture density: Optimum moisture
										Pct		Lb/ft3	Pct
Clime silty clay: (S79KS-073-006)													
A---------0 to 11	A-7-6(22)	CL	100	100	94	87	56	33	23	49	23	97	21
Bw--------11 to 23	A-7-6(16)	CL	100	100	80	74	56	39	27	45	22	100	21
Ivan silt loam: (S79KS-073-007)													
Ap---------0 to 7	A-6(10)	CL	100	100	100	90	48	17	9	32	12	107	16
AC--------16 to 38	A-6(17)	CL	100	100	100	91	54	24	14	38	18	104	18
C---------38 to 60	A-6(07)	CL	100	100	100	77	44	20	11	30	11	106	14
Niotaze loam: (S79KS-073-005)													
A---------0 to 3	A-6(11)	CL	100	100	95	81	57	27	18	38	14	96	19
2Bt--------9 to 22	A-7-6(17)	ML	100	100	98	93	85	66	55	44	16	95	25

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aquents	Loamy and clayey, mixed, mesic Typic Fluvaquents
Chase	Fine, montmorillonitic, mesic Aquic Argiudolls
Clime	Fine, mixed, mesic Udorthentic Haplustolls
Darnell	Loamy, siliceous, thermic, shallow Udic Ustochrepts
Dennis	Fine, mixed, thermic Aquic Paleudolls
Dwight	Fine, montmorillonitic, mesic Typic Natrustolls
Eram	Fine, mixed, thermic Aquic Argiudolls
Florence	Clayey-skeletal, montmorillonitic, mesic Udic Argiustolls
Ivan	Fine-silty, mixed, mesic Cumulic Hapludolls
Kenoma	Fine, montmorillonitic, thermic Vertic Argiudolls
Labette	Fine, mixed, mesic Udic Argiustolls
Martin	Fine, montmorillonitic, mesic Aquic Argiudolls
Newtonia	Fine-silty, mixed, thermic Typic Paleudolls
Niotaze	Fine, montmorillonitic, thermic Aquic Paleustalfs
Olpe	Clayey-skeletal, montmorillonitic, thermic Typic Paleudolls
Osage	Fine, montmorillonitic, thermic Vertic Haplaquolls
Reading	Fine-silty, mixed, mesic Typic Argiudolls
Sogn	Loamy, mixed, mesic Lithic Haplustolls
Steedman	Fine, montmorillonitic, thermic Vertic Haplustalfs
Woodson	Fine, montmorillonitic, thermic Abruptic Argiaquolls
Zaar	Fine, montmorillonitic, thermic Vertic Hapludolls

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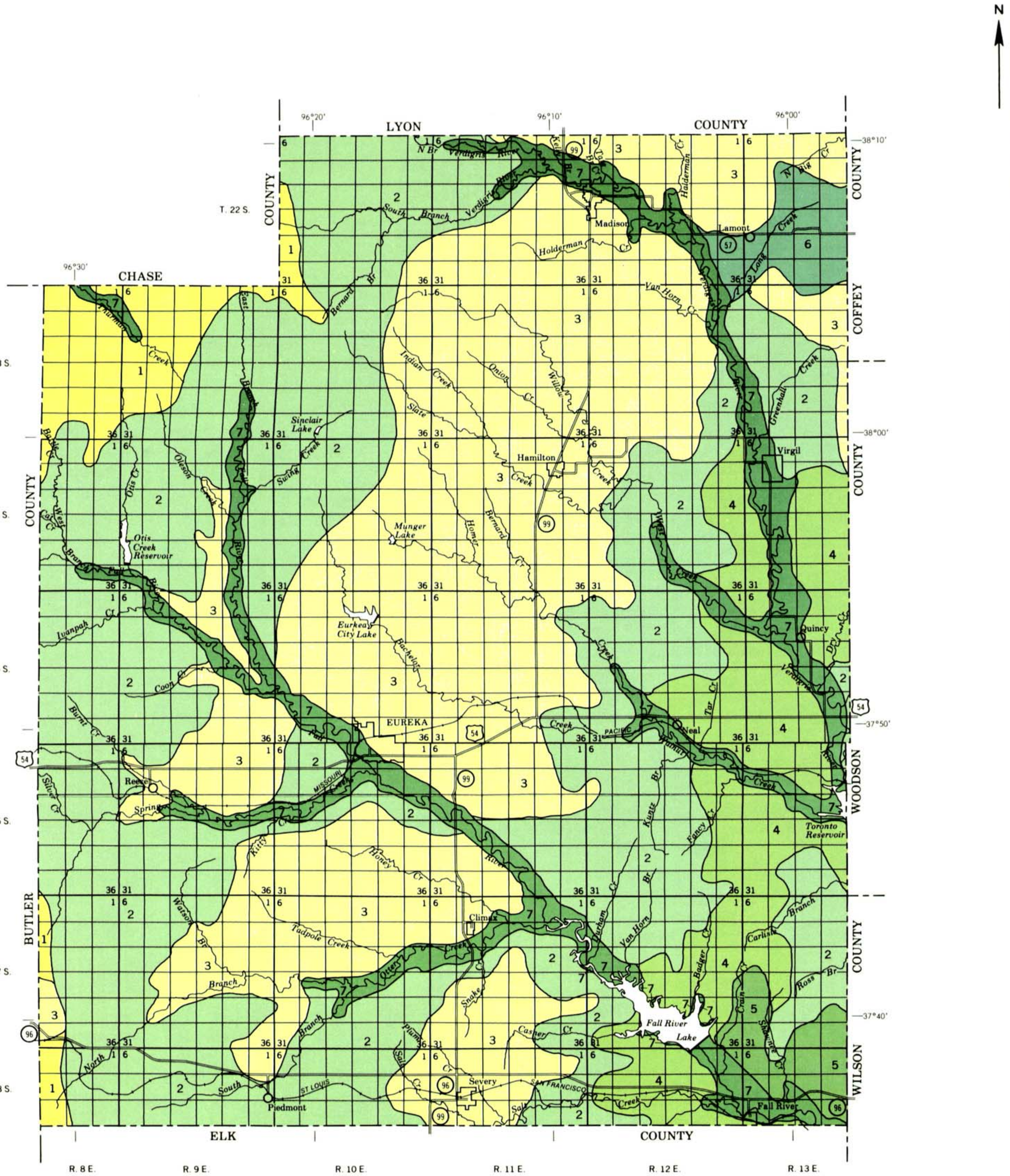


SOIL LEGEND

1	Florence-Labette association: Deep and moderately deep, nearly level to strongly sloping, well drained soils that have a dominantly clayey or cherty clay subsoil; on uplands
2	Clime-Sogn-Martin association: Deep to shallow, nearly level to moderately steep, moderately well drained to somewhat excessively drained soils that have a clayey or silty subsoil; on uplands
3	Eram-Labette-Kenoma association: Moderately deep and deep, nearly level to moderately sloping, moderately well drained and well drained soils that have a dominantly clayey subsoil; on uplands and high terraces
4	Steedman-Dennis-Eram association: Moderately deep and deep, gently sloping to strongly sloping, moderately well drained soils that have a dominantly clayey subsoil; on uplands
5	Niotaze-Darnell-Steedman association: Moderately deep and shallow, nearly level to steep, somewhat poorly drained to well drained soils that have a clayey or loamy subsoil; on uplands
6	Olpe-Kenoma association: Deep, gently sloping to strongly sloping, well drained and moderately well drained soils that have a dominantly clayey or gravelly and clayey subsoil; on uplands
7	Reading-Ivan-Chase association: Deep, nearly level, well drained and somewhat poorly drained soils that have a silty or clayey subsoil; on low terraces and flood plains

Compiled 1982

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
GREENWOOD COUNTY, KANSAS

Scale 1: 253,440

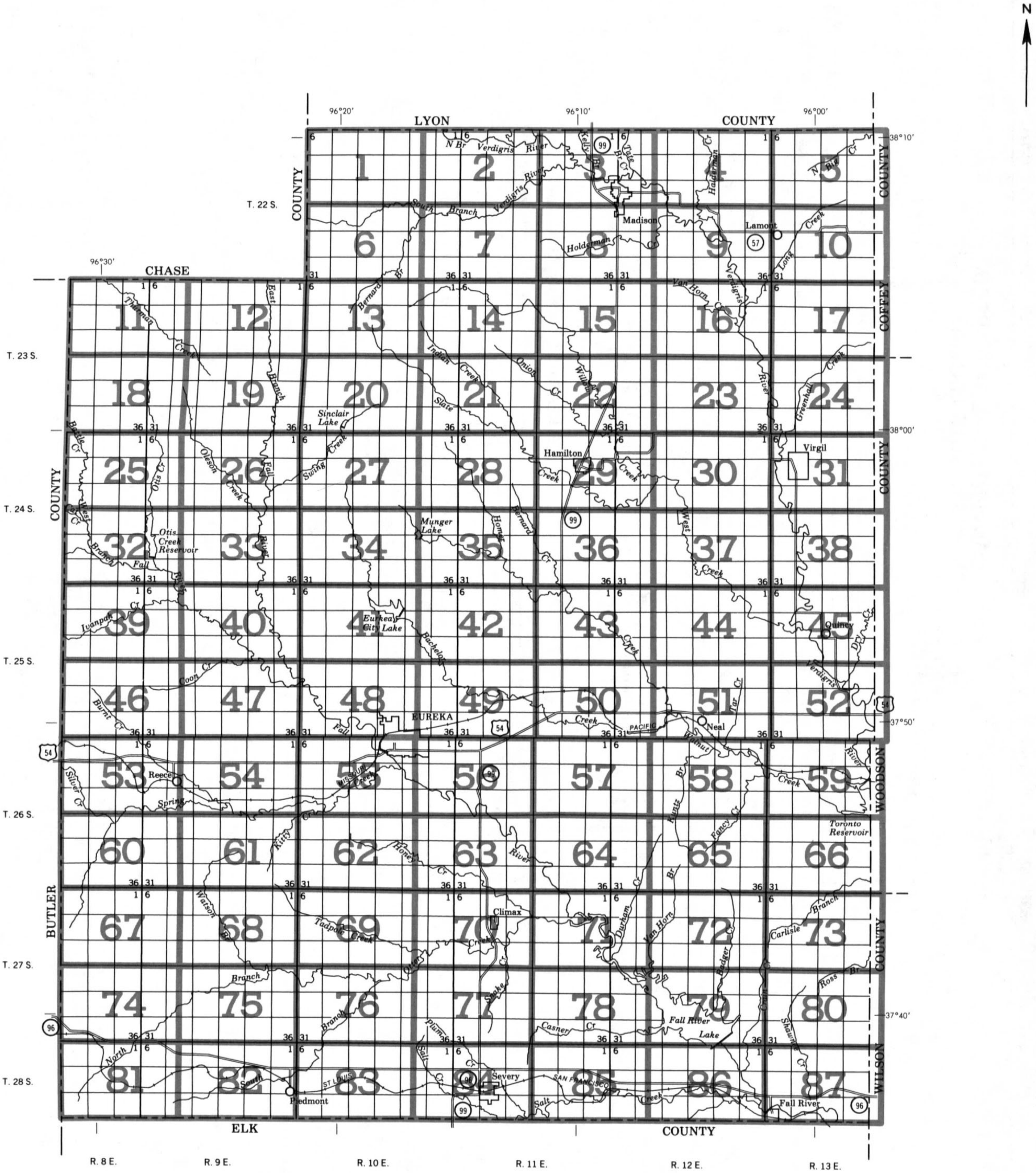
1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



Original text from each individual map sheet read:
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS
GREENWOOD COUNTY, KANSAS

Scale 1:253,440
1 0 1 2 3 4 Miles
1 0 1 2 3 4 5 6 Kilometers

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

SYMBOL	NAME
At	Aquents, flooded
Ca	Chase silty clay loam
Ce	Clime stony silty clay loam, 20 to 30 percent slopes
Cm	Clime silty clay, 3 to 7 percent slopes
Cs	Clime-Sogn complex, 5 to 20 percent slopes
De	Dennis silt loam, 1 to 4 percent slopes
Dn	Dennis silt loam, 4 to 7 percent slopes
Ds	Dennis silty clay loam, 2 to 6 percent slopes, eroded
Dw	Dwight silt loam, 0 to 2 percent slopes
Eb	Eram silty clay loam, 1 to 4 percent slopes
Ec	Eram silty clay loam, 4 to 7 percent slopes
Eh	Eram silty clay loam, 3 to 7 percent slopes, eroded
Ft	Florence-Labette complex, 2 to 12 percent slopes
Ic	Ivan silt loam, channeled
If	Ivan silt loam, occasionally flooded
Ka	Kenoma silt loam, 1 to 4 percent slopes
Ke	Kenoma silty clay loam, 2 to 5 percent slopes, eroded
La	Labette silty clay loam, 1 to 4 percent slopes
Ld	Labette-Dwight complex, 0 to 3 percent slopes
Ls	Labette-Sogn silty clay loams, 0 to 8 percent slopes
Ma	Martin silty clay loam, 1 to 4 percent slopes
Mb	Martin silty clay loam, 4 to 7 percent slopes
Me	Martin silty clay, 3 to 7 percent slopes, eroded
Na	Newtonia silt loam, 0 to 2 percent slopes
Nd	Niotaze-Darnell complex, 0 to 6 percent slopes
Nz	Niotaze-Darnell complex, 6 to 35 percent slopes
Od	Oil wasteland
Op	Olpe gravelly silt loam, 4 to 15 percent slopes
Os	Osage silty clay
Pt	Pits, quarries
Re	Reading silt loam
St	Steedman stony loam, 3 to 12 percent slopes
Wo	Woodson silt loam, 0 to 2 percent slopes
Za	Zaar silty clay, 0 to 2 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

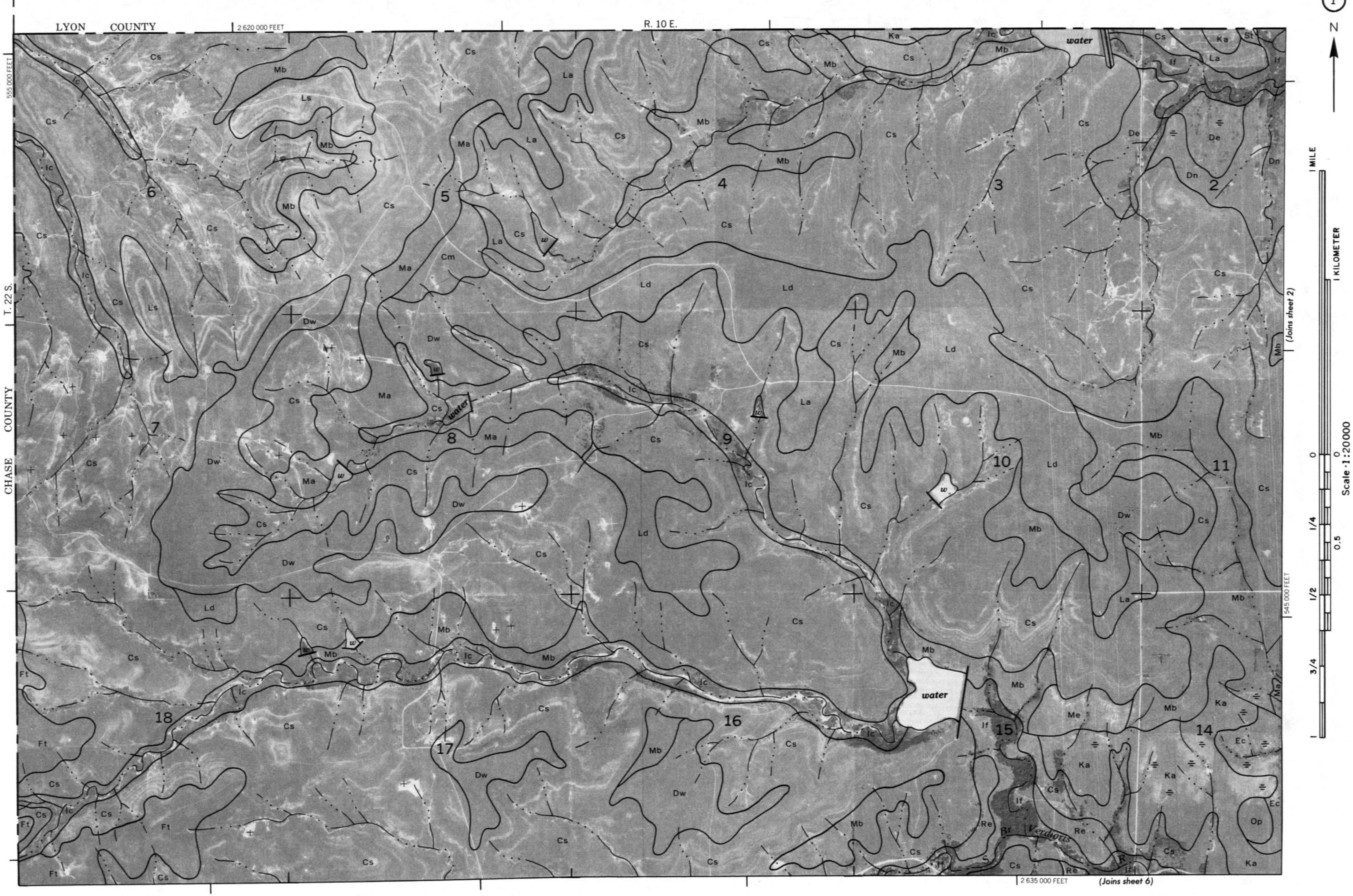
DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Borrow area up to 5 acres in size

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 1



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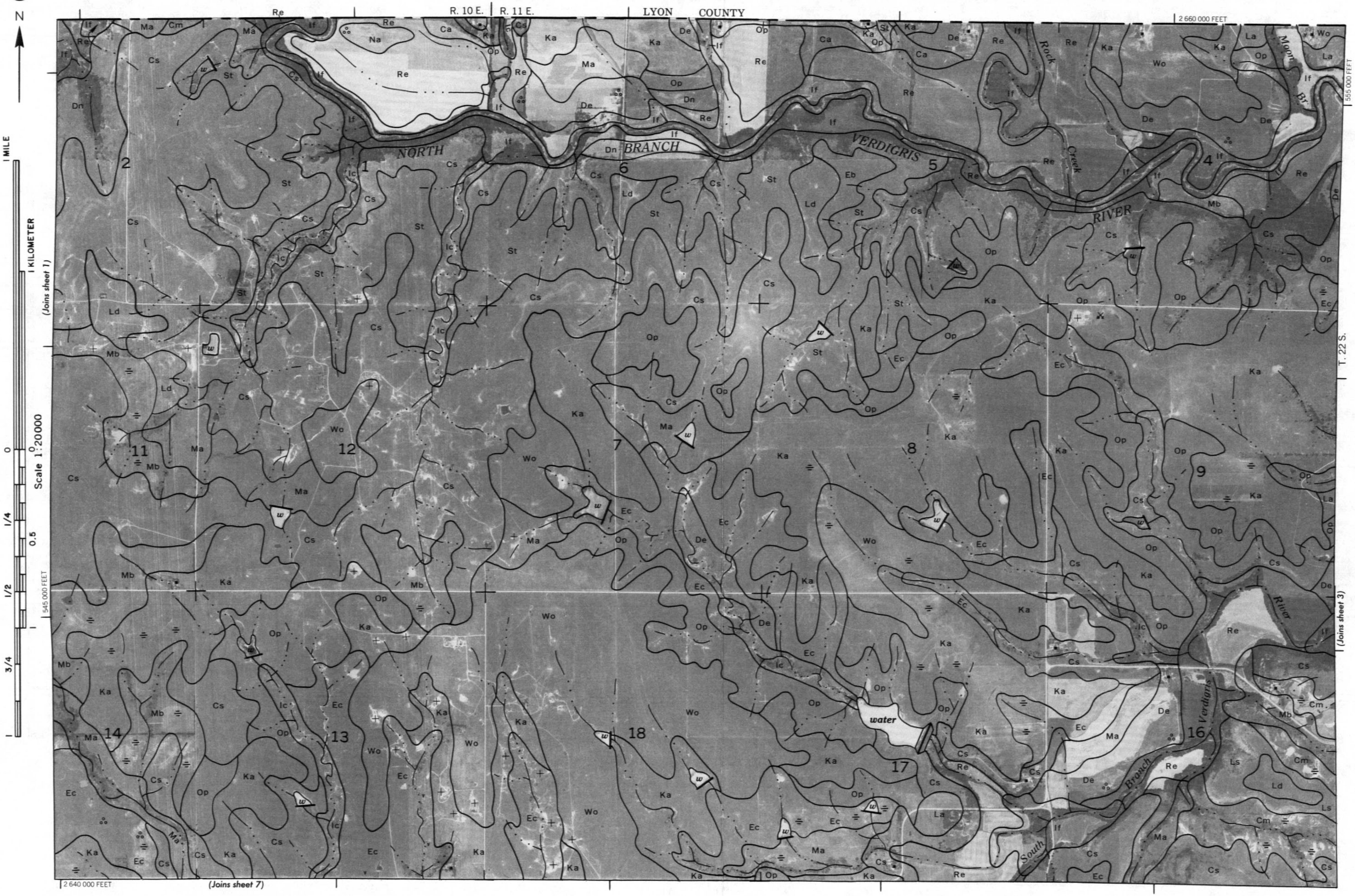
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 2

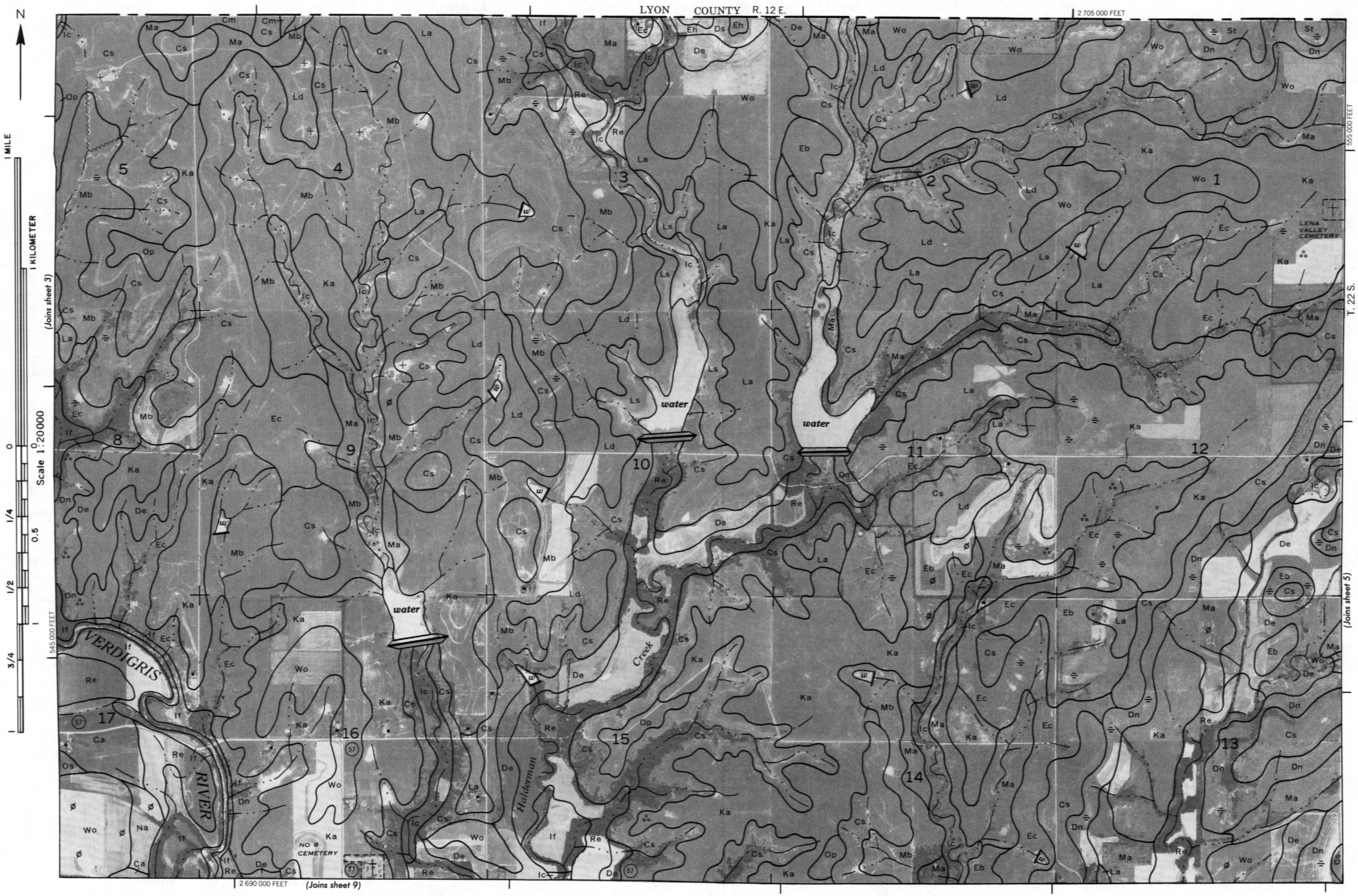


SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 3

3

4

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 4



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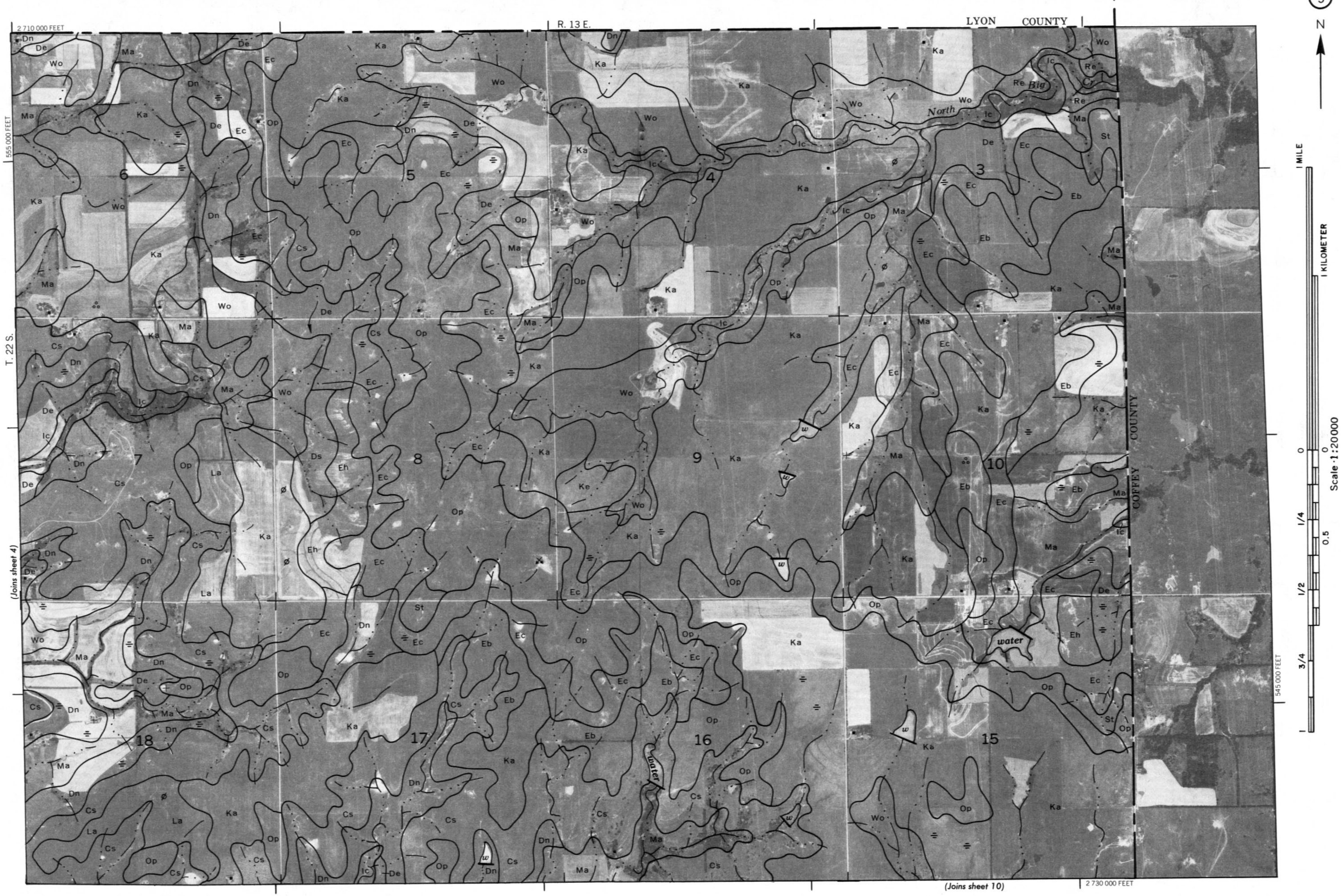

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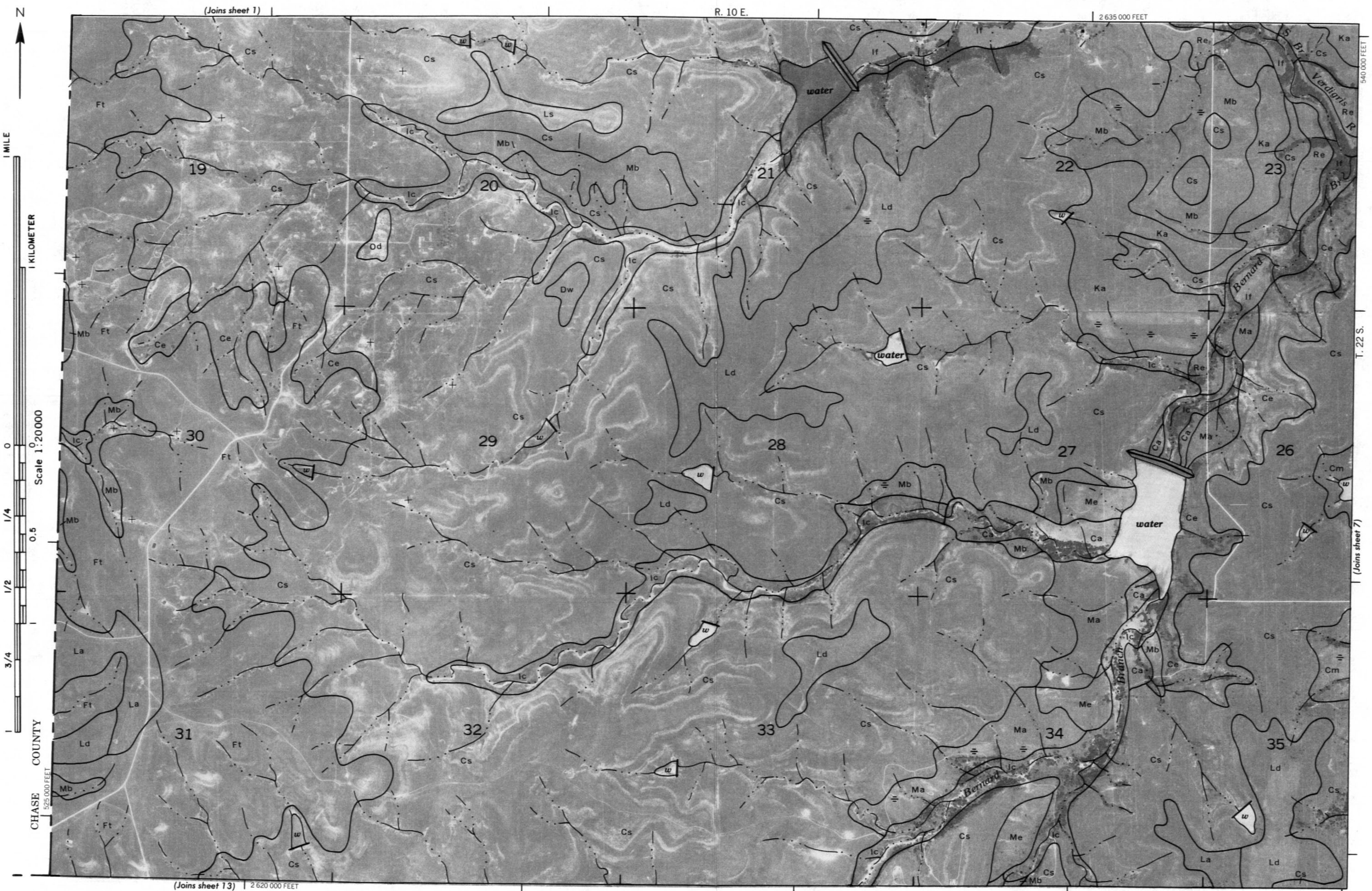

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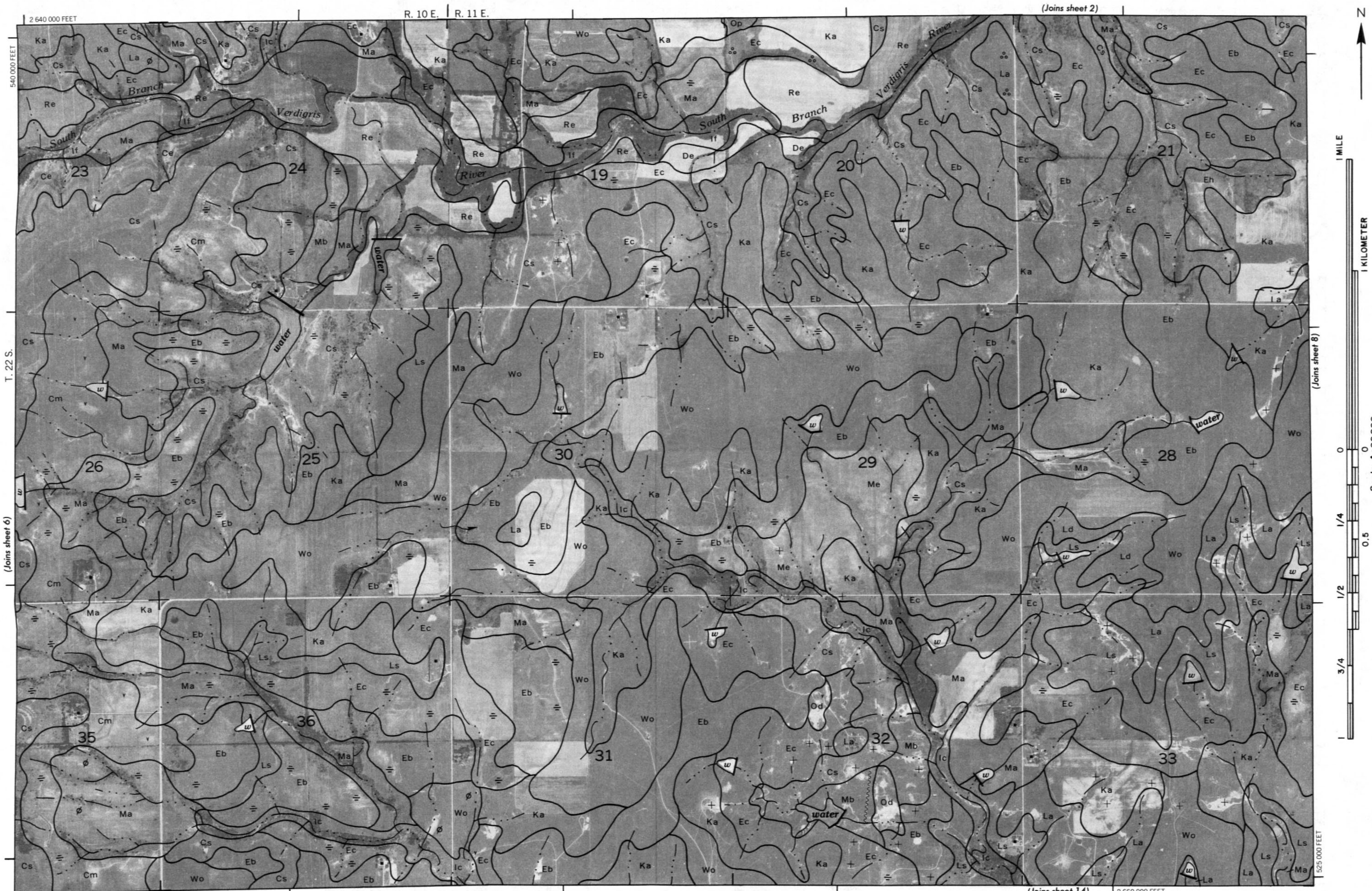
7



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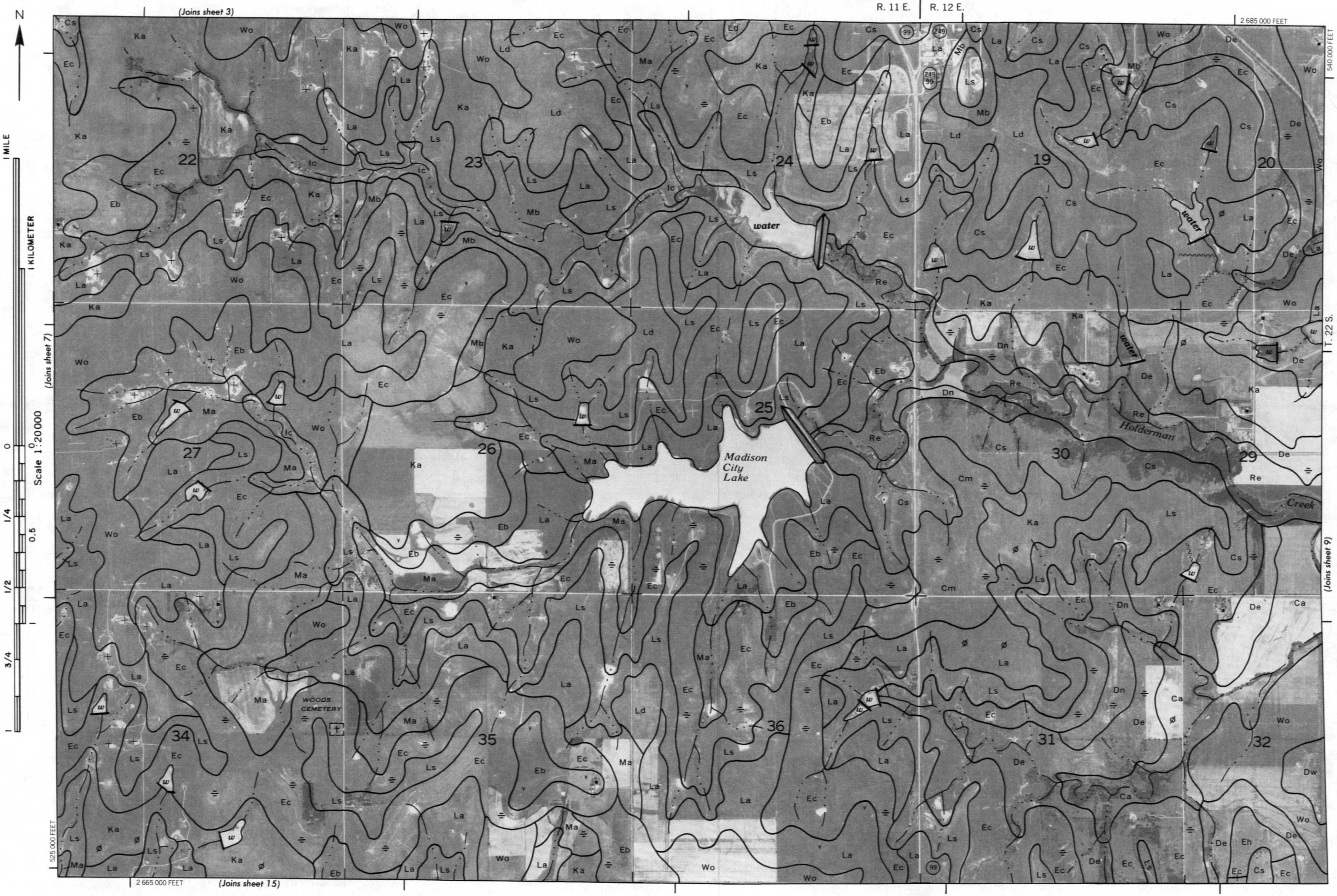

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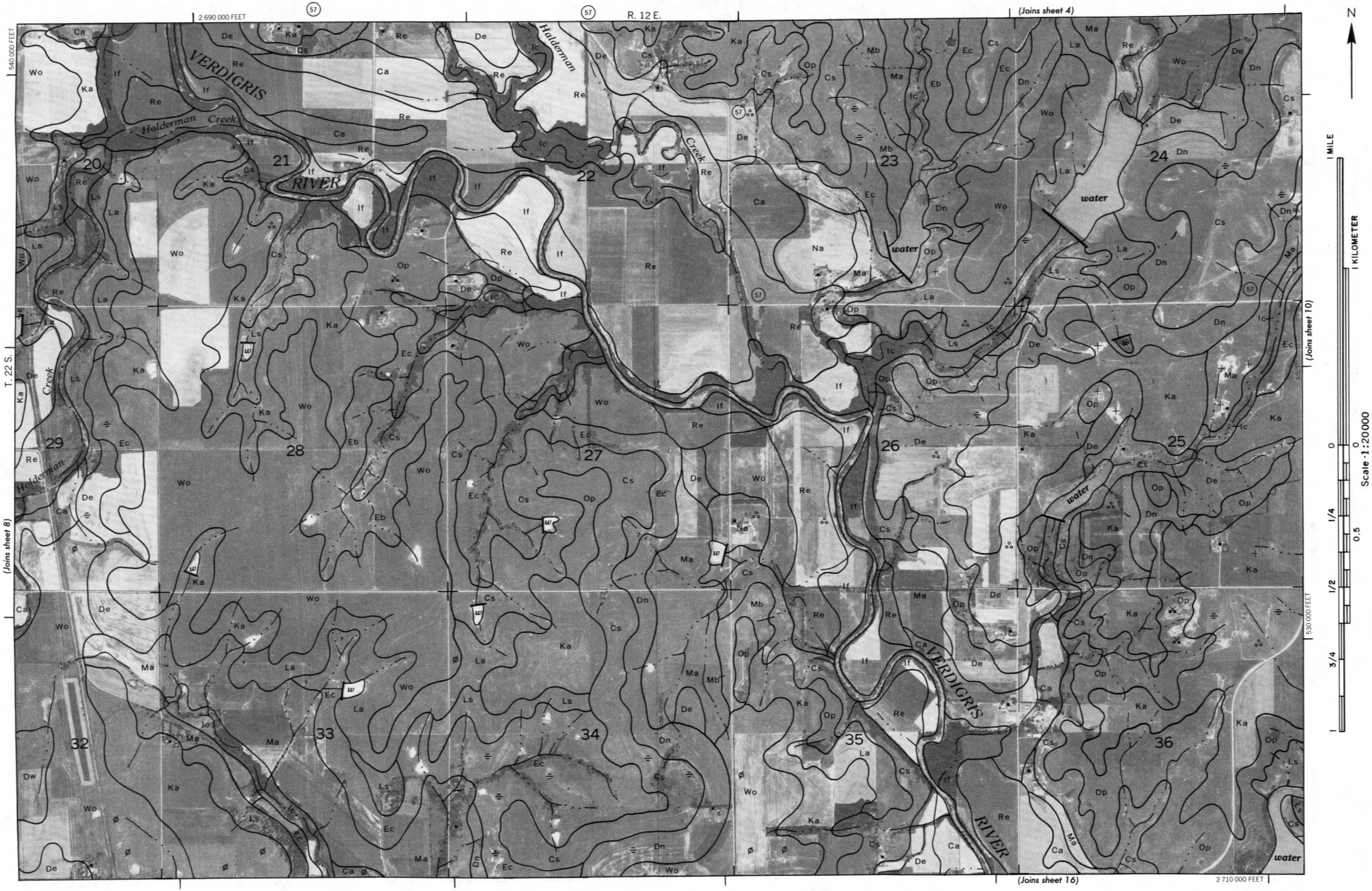

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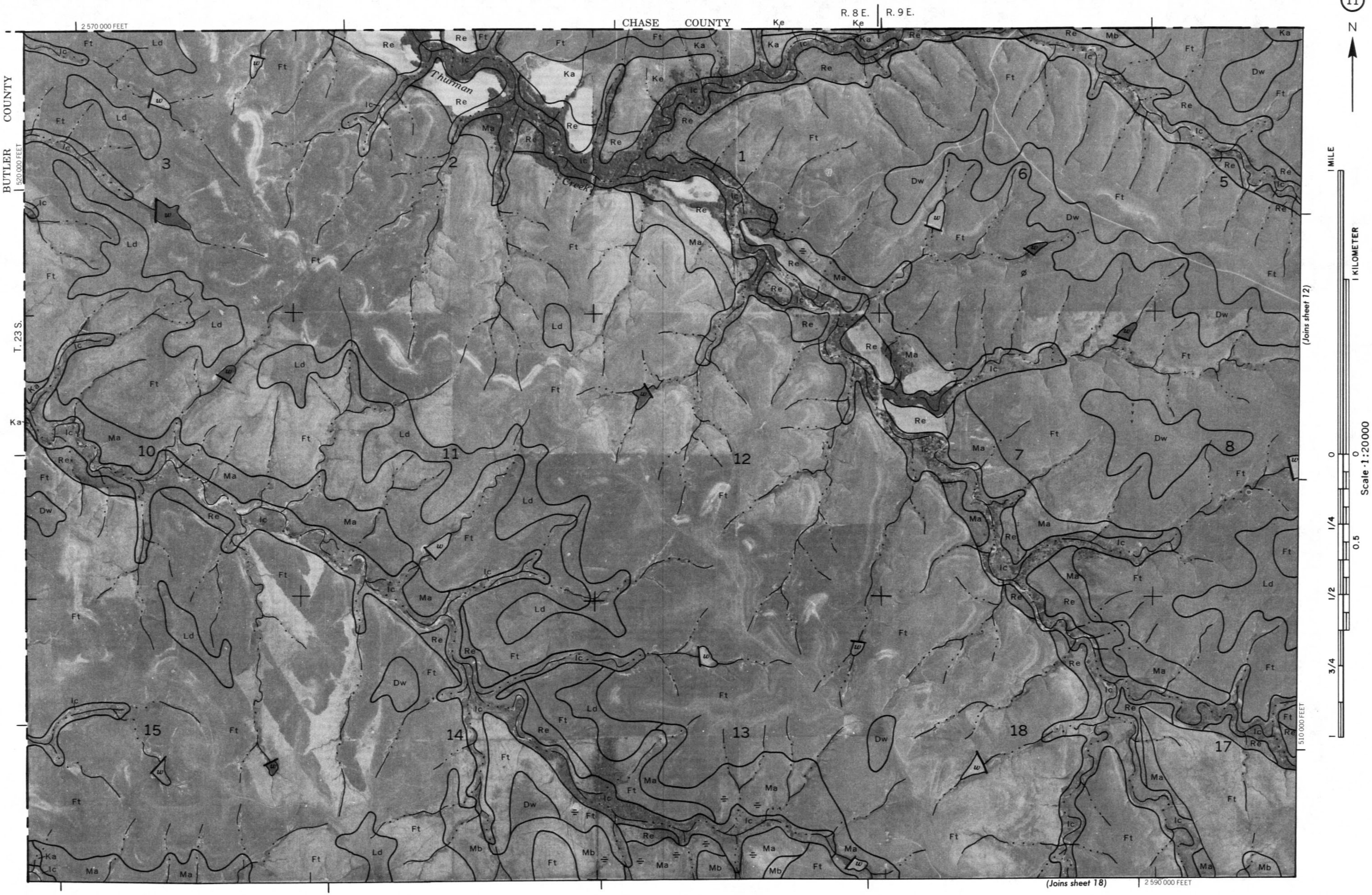

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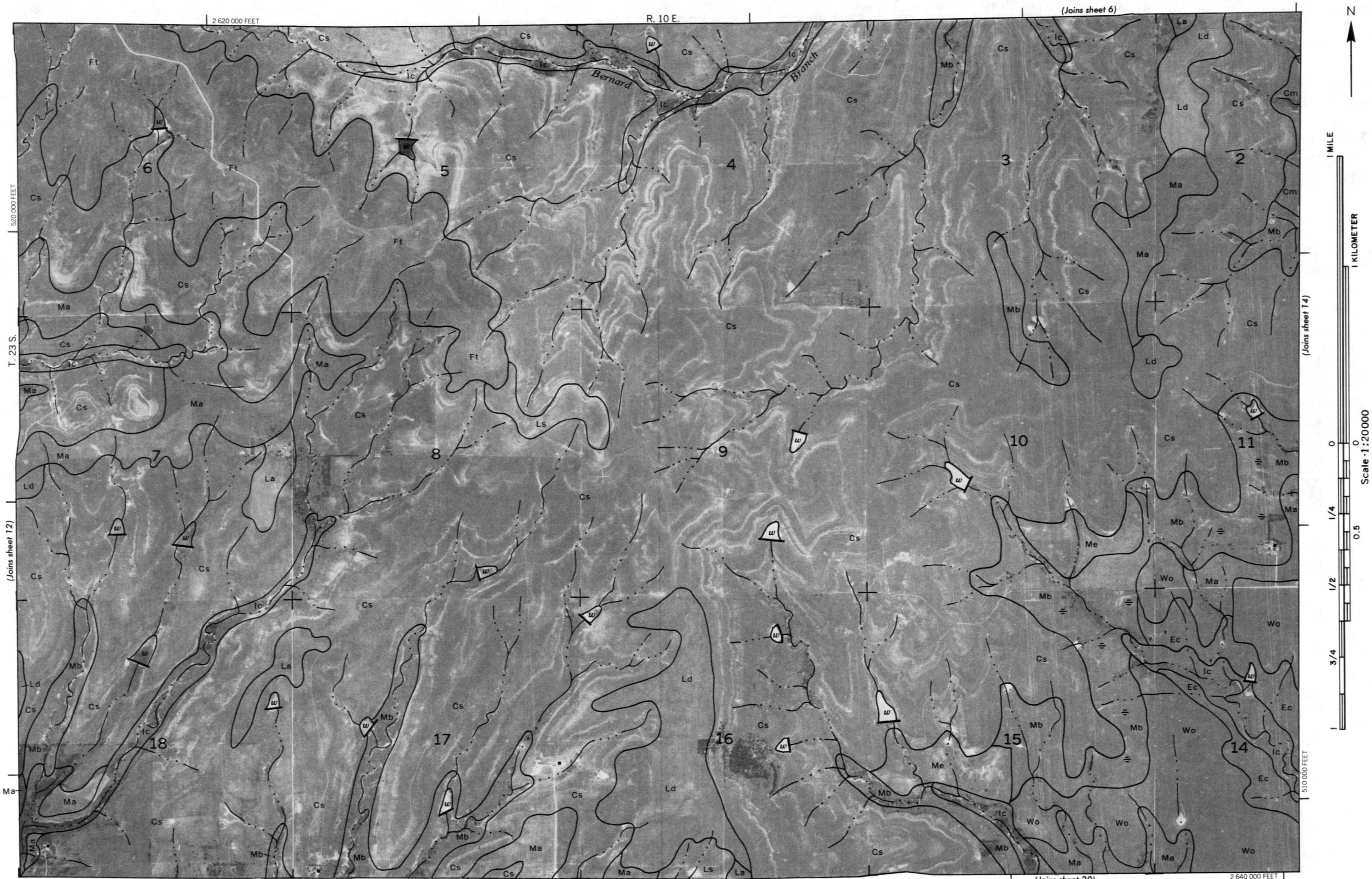
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 12

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 13



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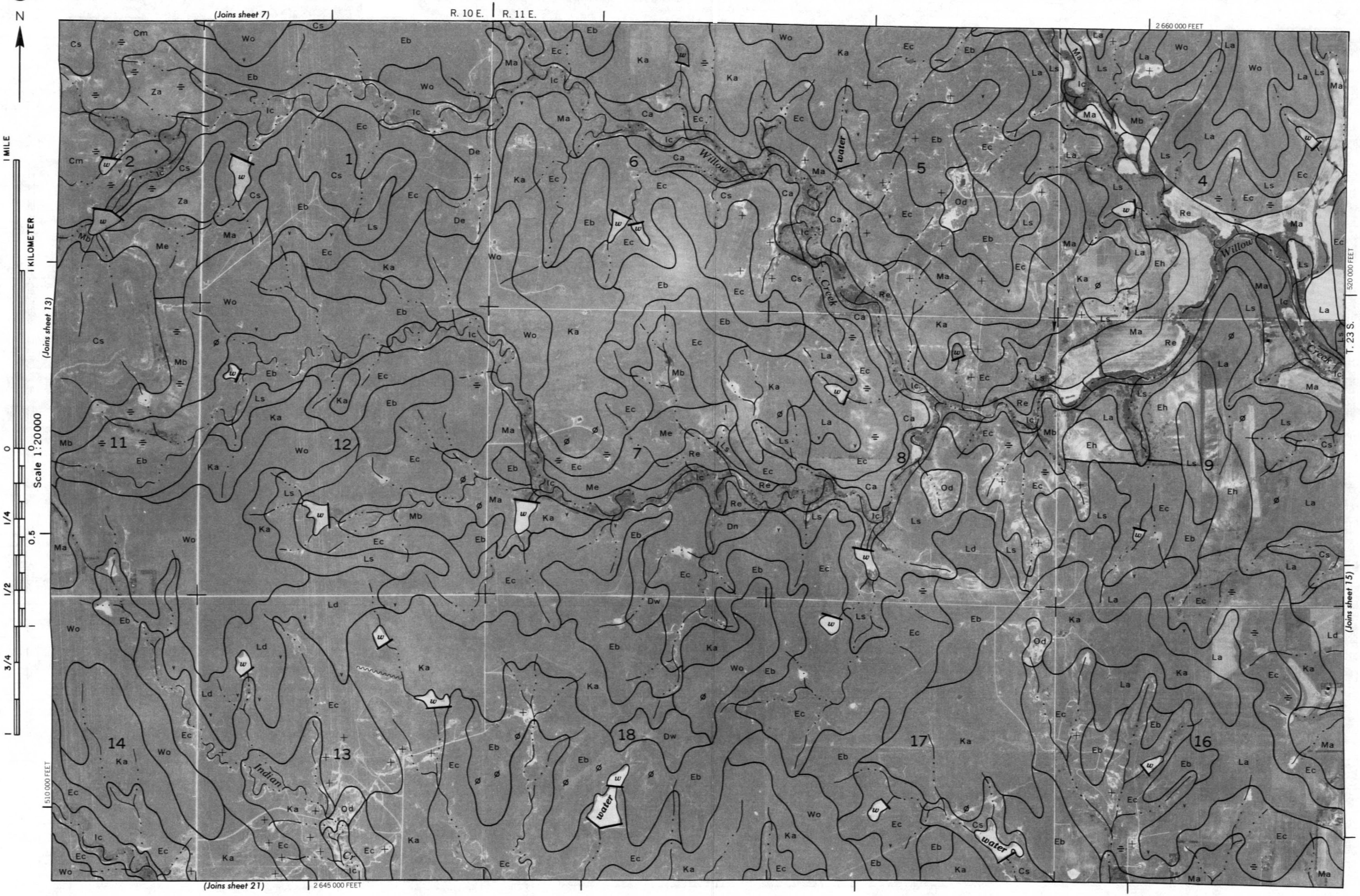

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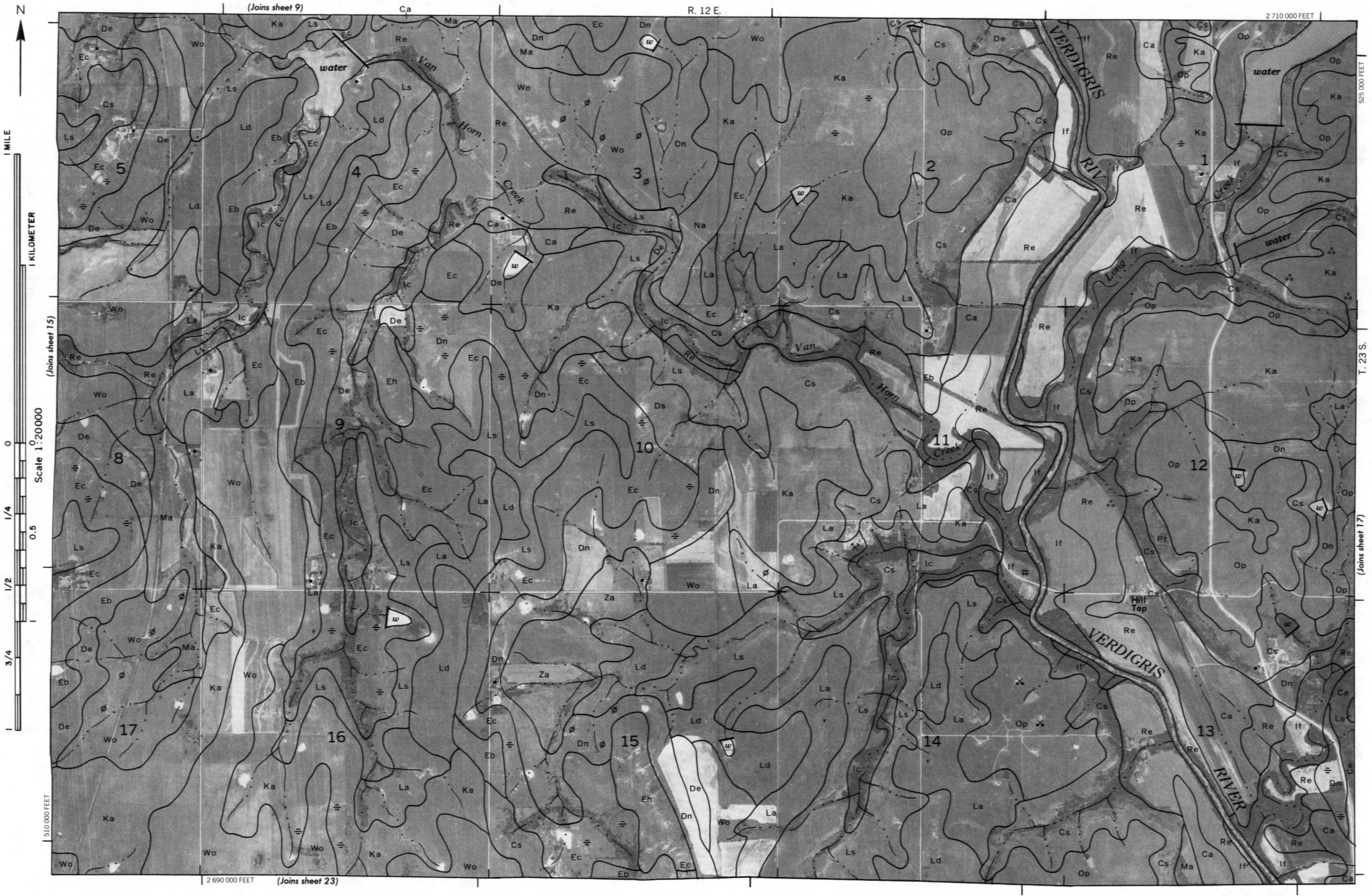
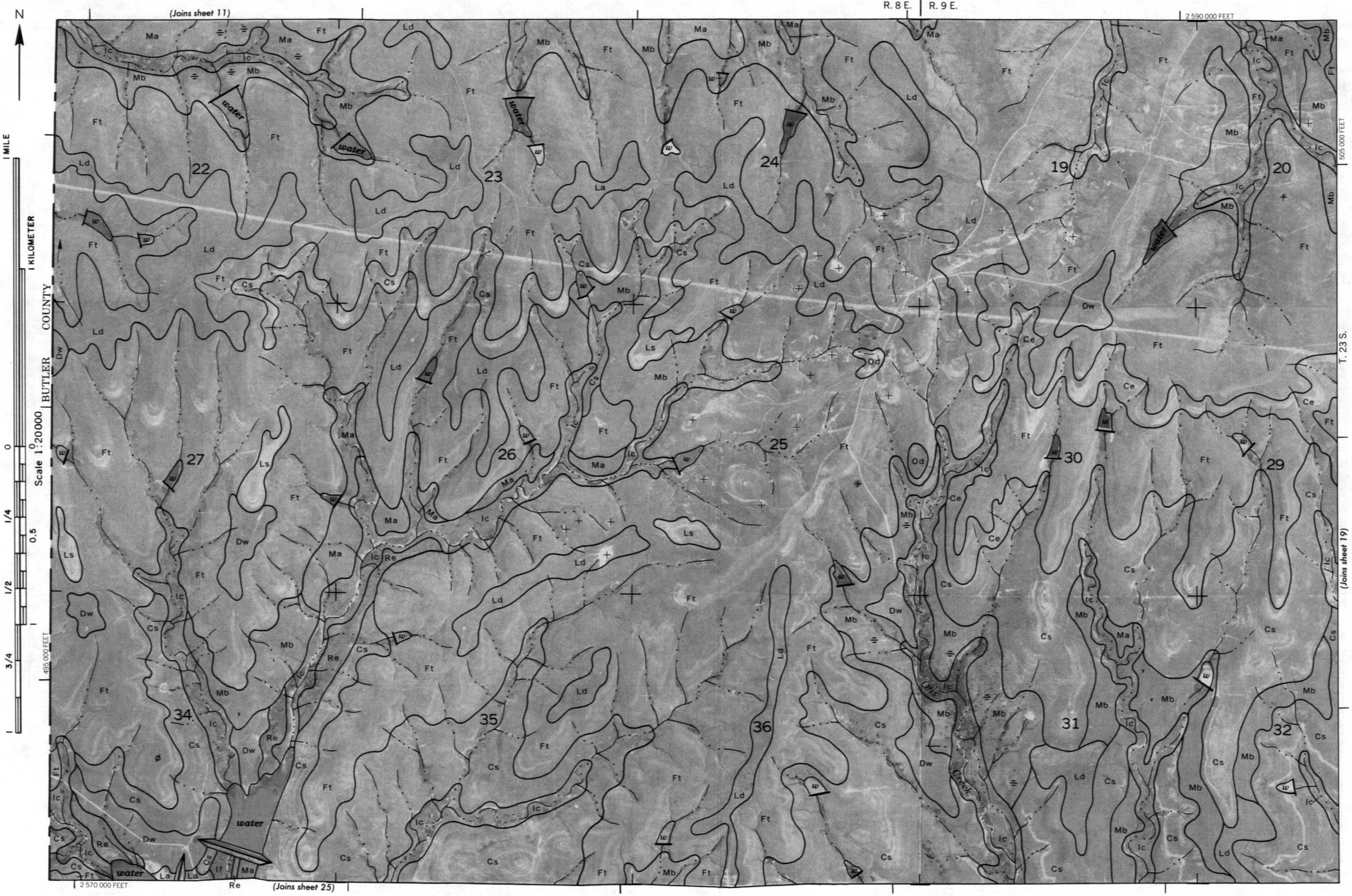


SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 17

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 18



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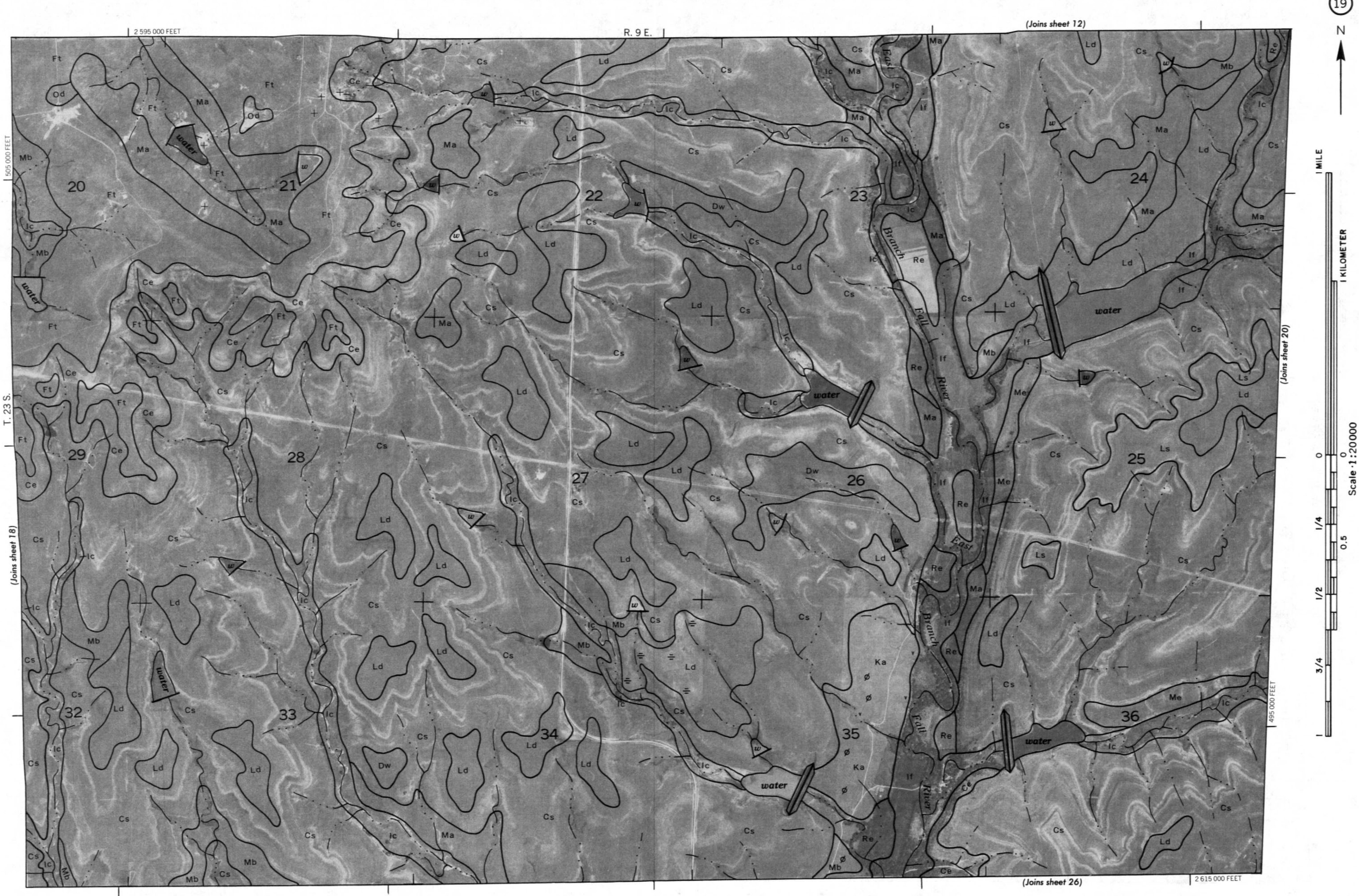

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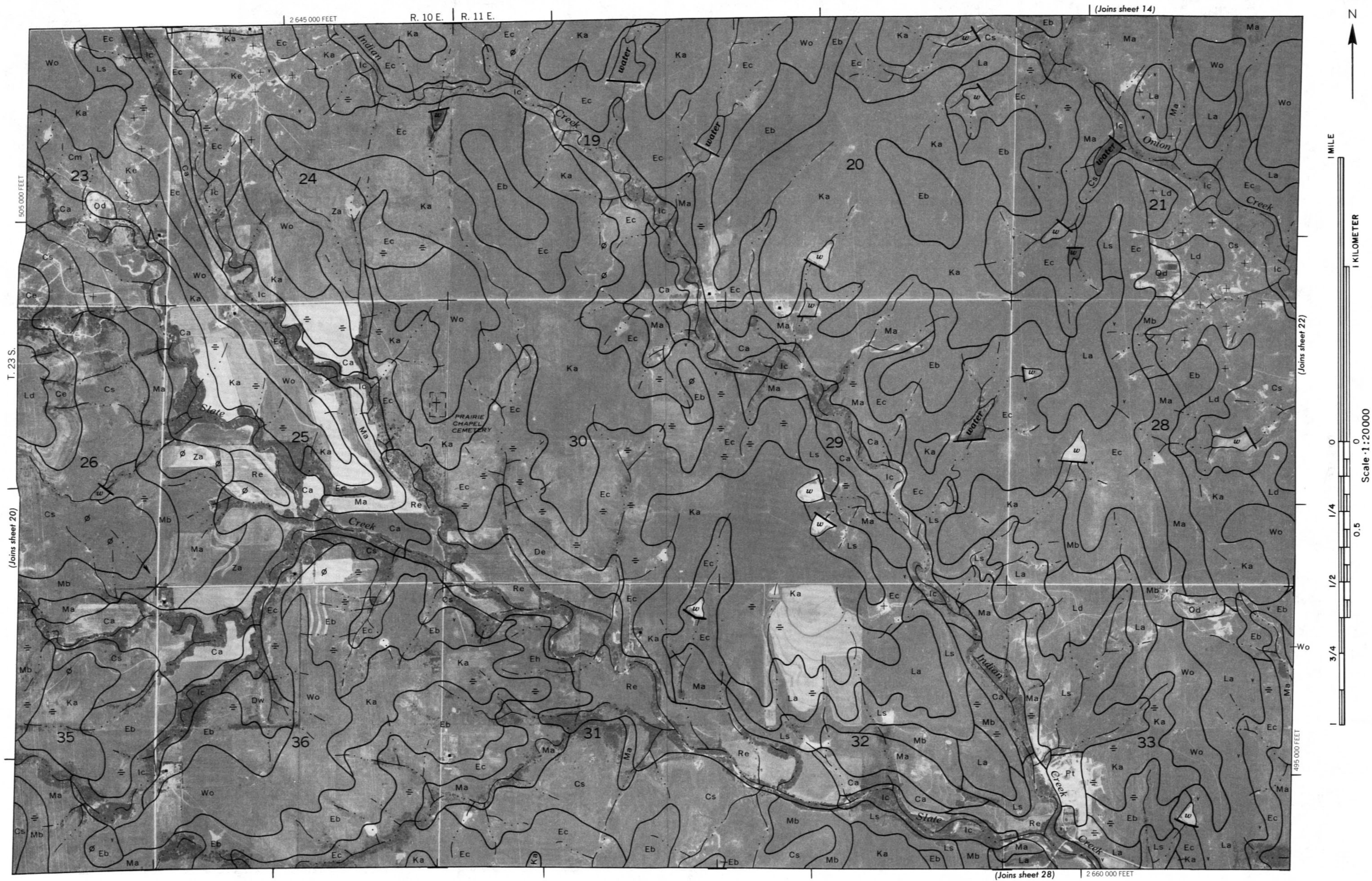

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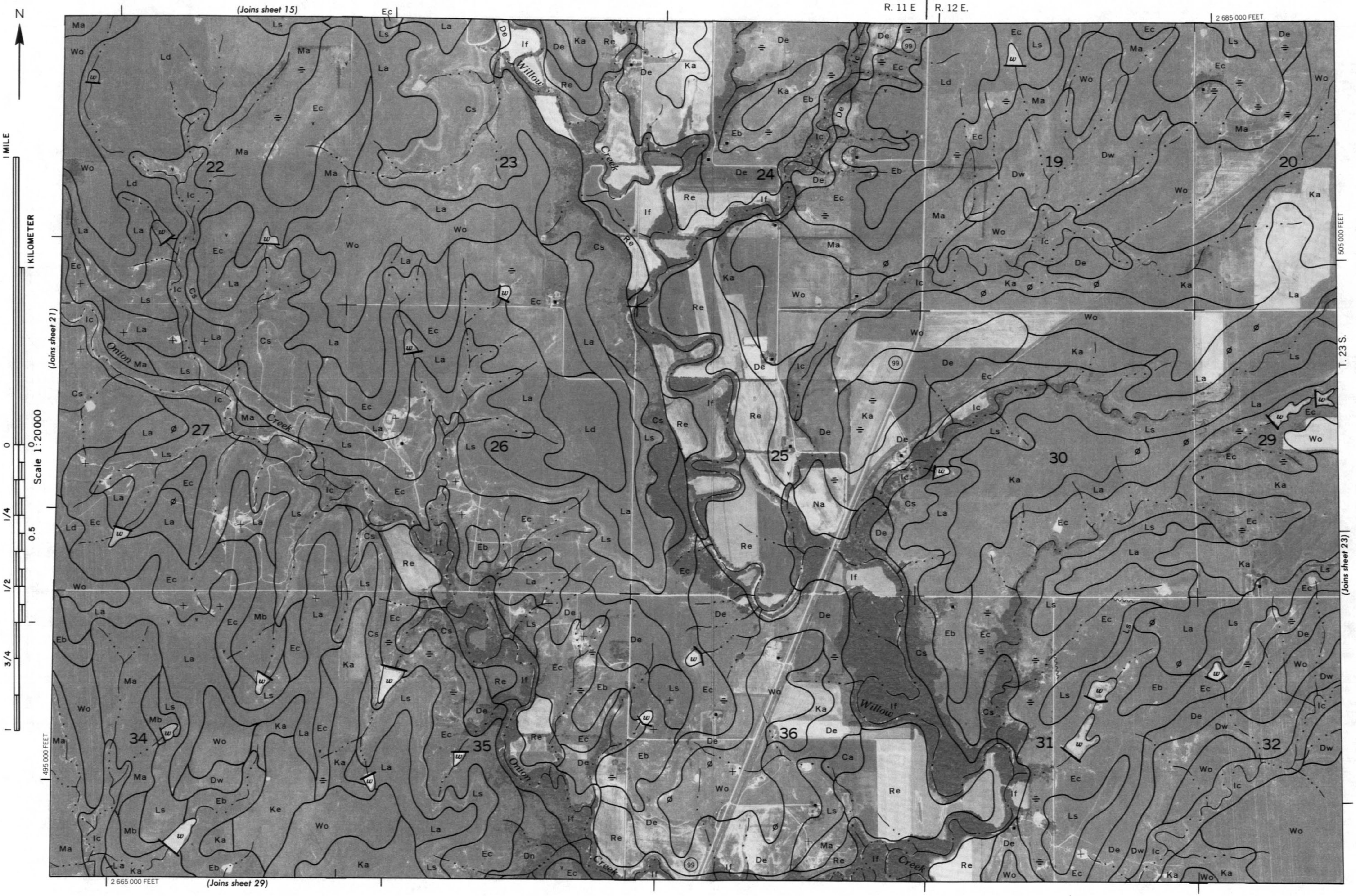
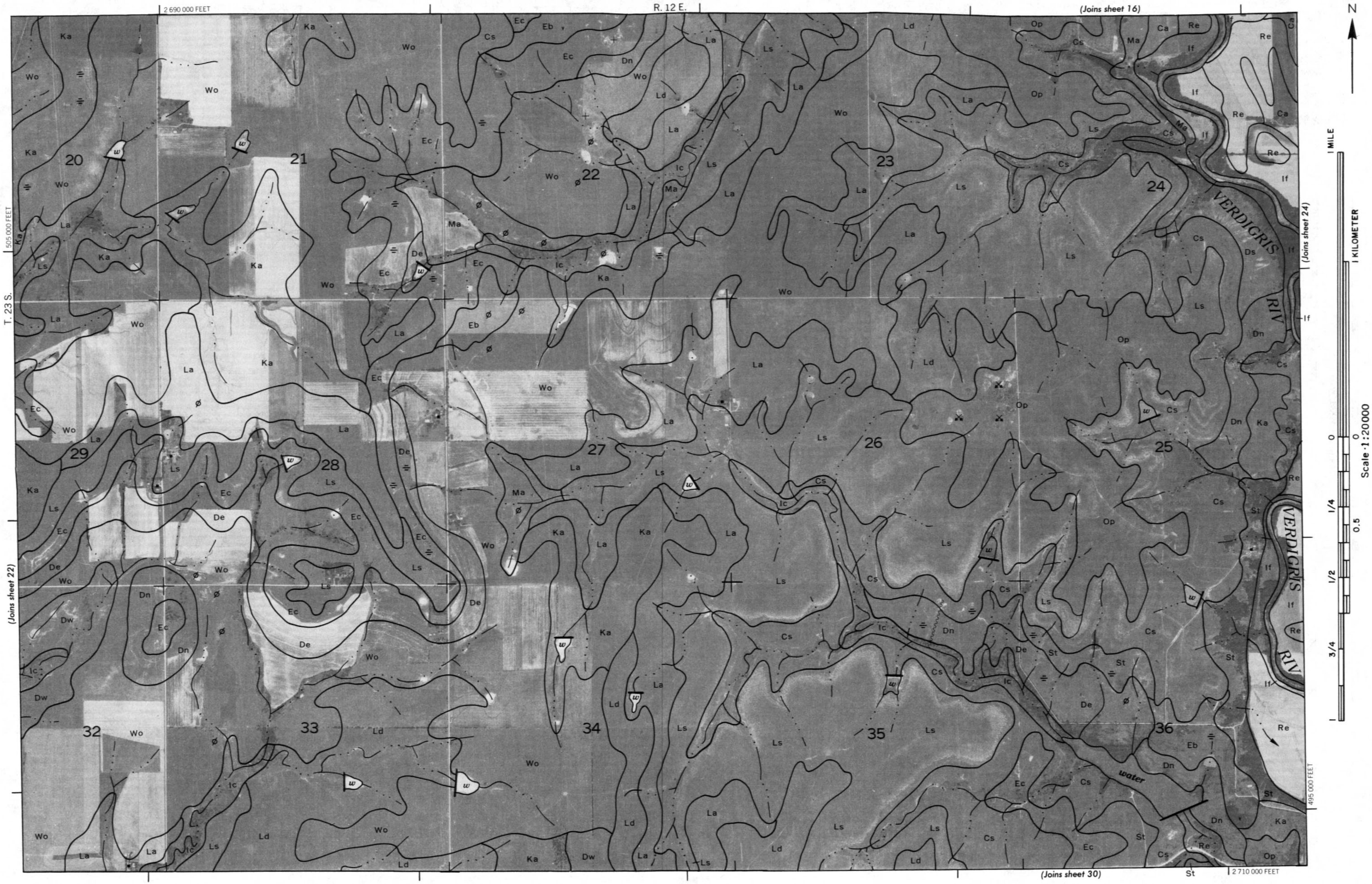
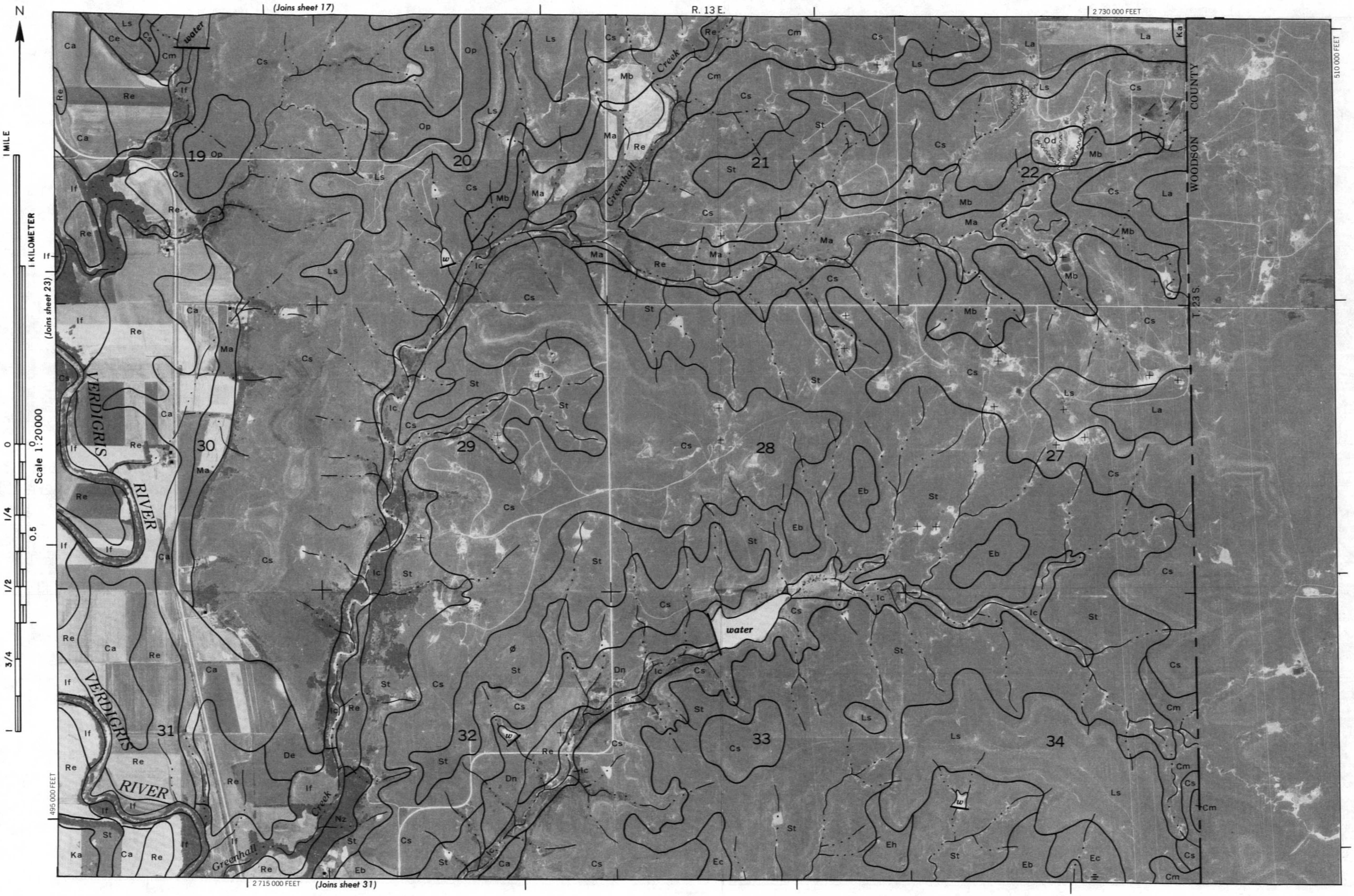



2 690 000 FEET
R. 12 E.
(Joins sheet 16)
505 000 FEET
T. 23 S.
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 30)
495 000 FEET
2 710 000 FEET
VERDIGRIS RIV
water
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 24



SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 25

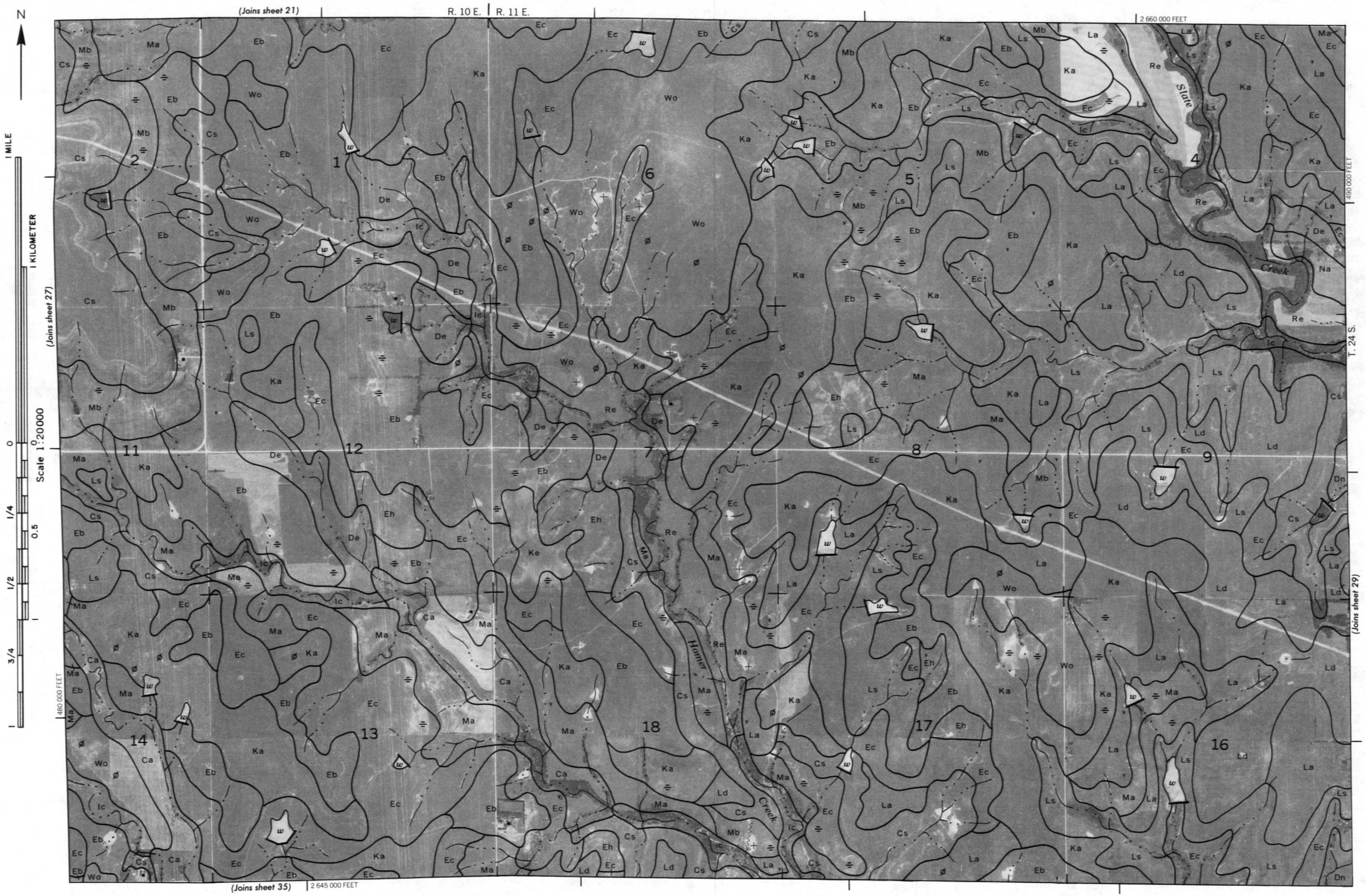
25

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 26

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 27

27

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 28



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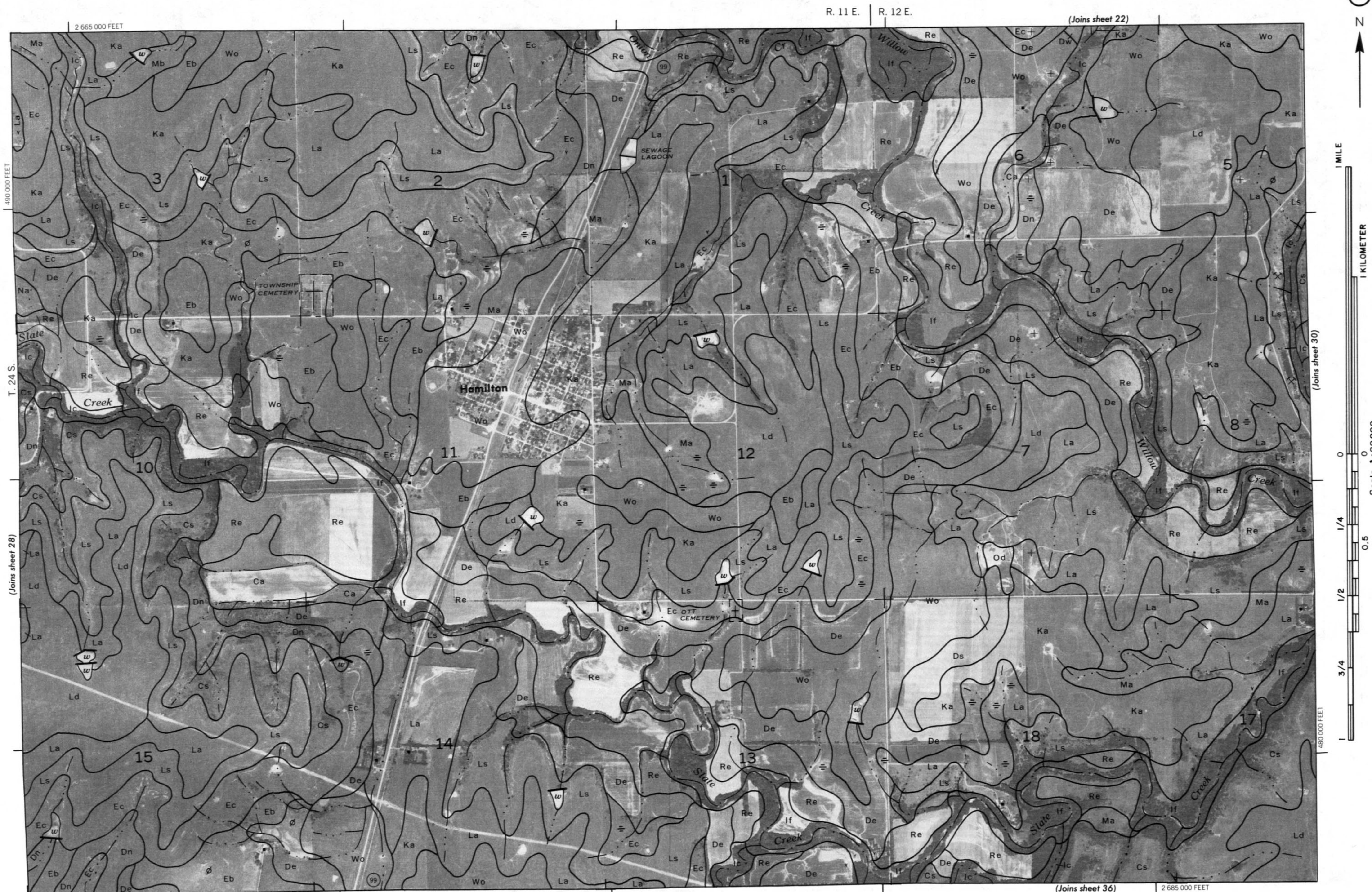

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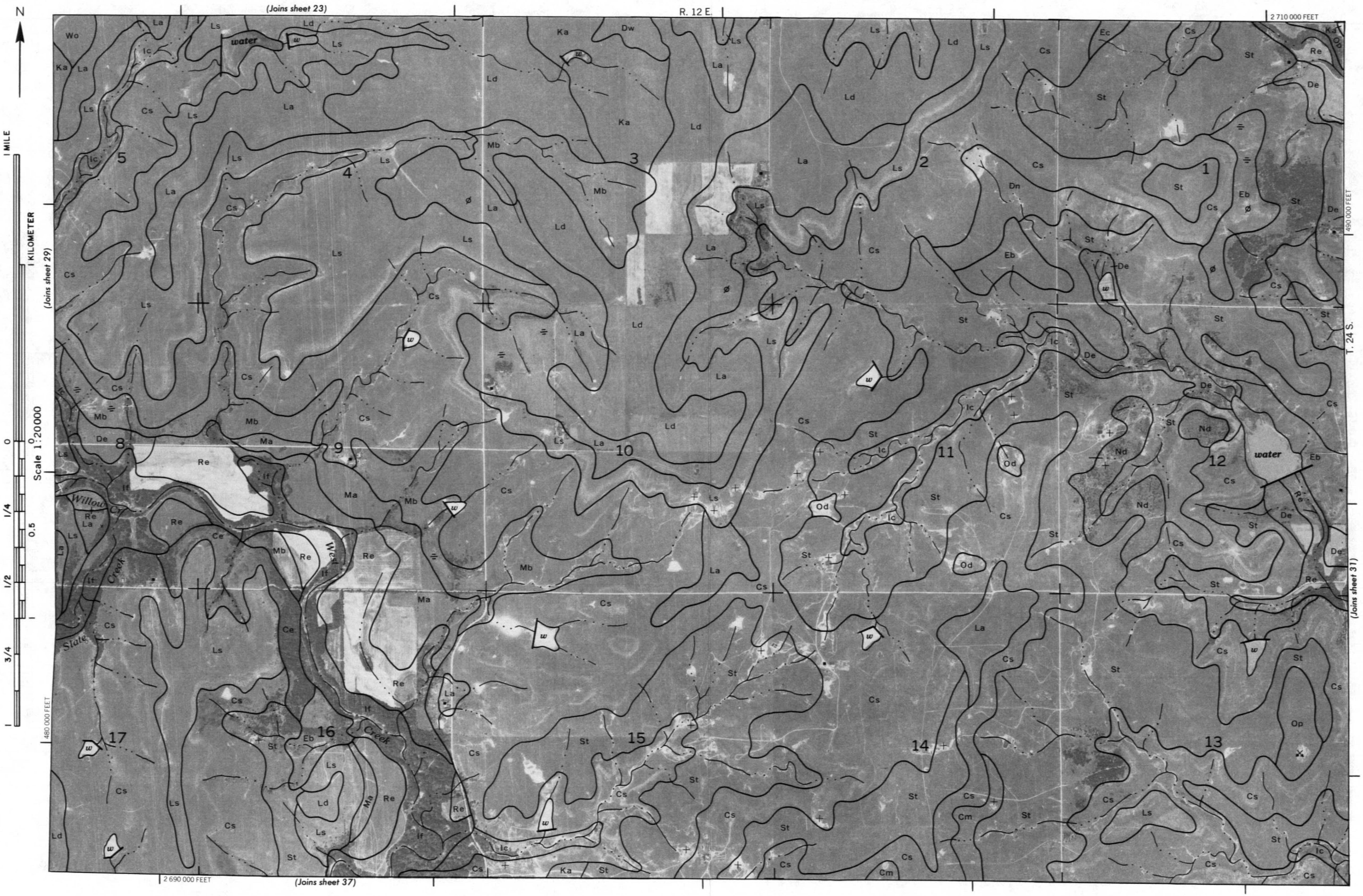

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 31

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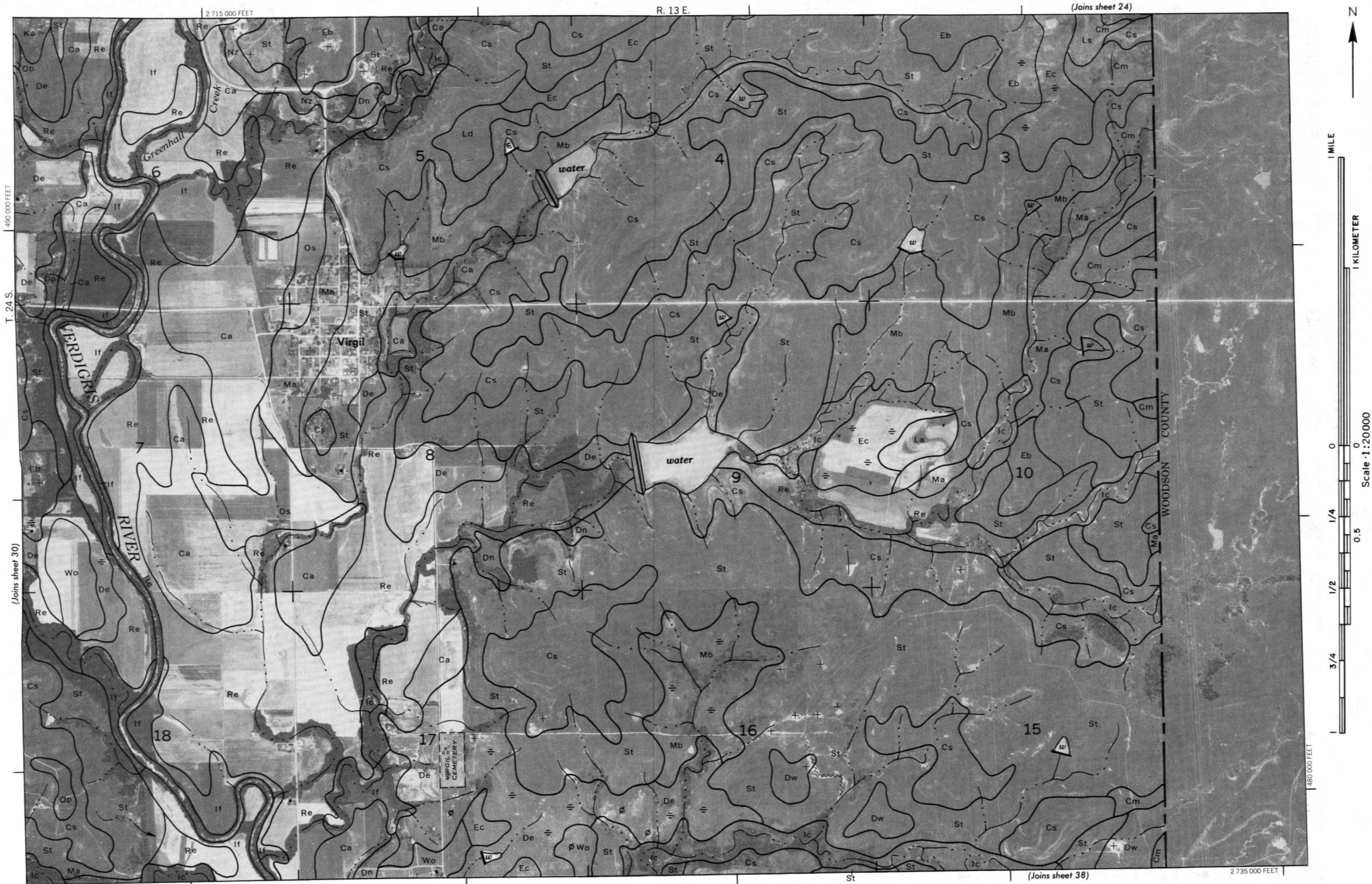
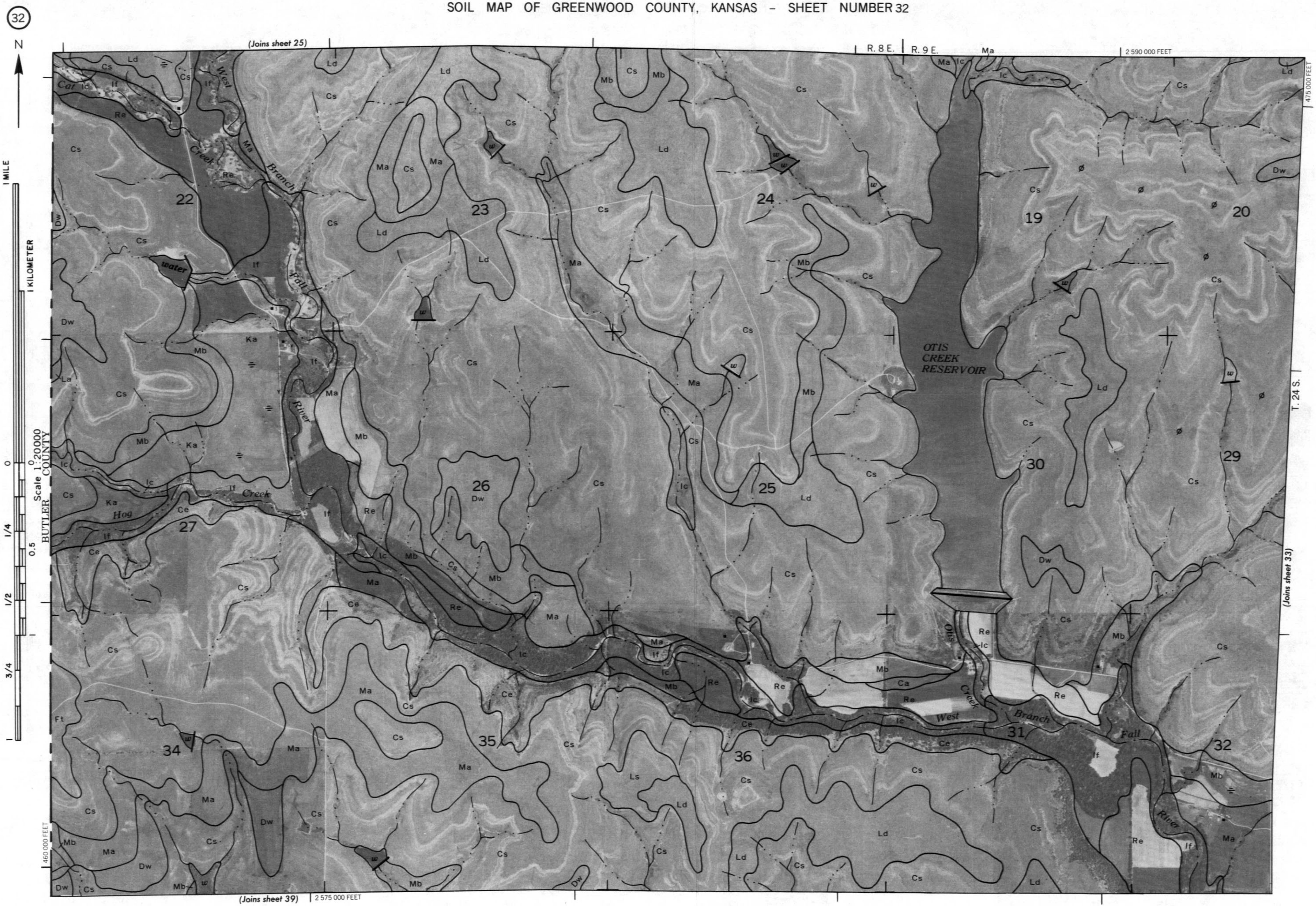
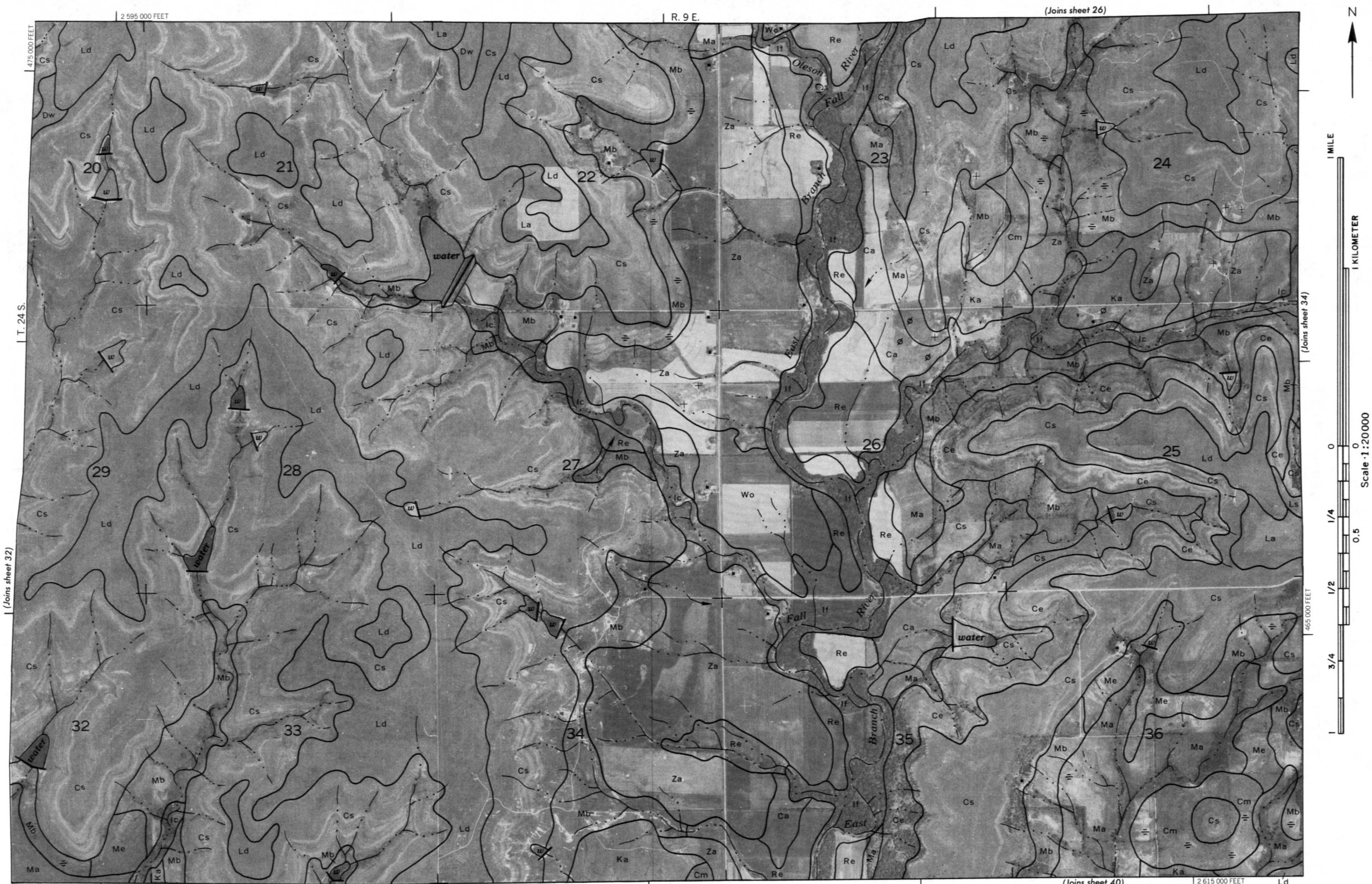



32
N
1 MILE
1 KILOMETER
Scale 1:20000
BUTLER COUNTY
(Joins sheet 25)
R. 8 E.
R. 9 E.
2 590 000 FEET
475 000 FEET
T. 24 S.
(Joins sheet 33)
(Joins sheet 39)
2 575 000 FEET
460 000 FEET
OTIS CREEK RESERVOIR
Cat Creek
West Branch
Fall River
Hog Creek
Otis Creek
West Branch
Fall River
water
22
23
24
19
20
26
25
30
29
27
34
35
36
31
32

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 33



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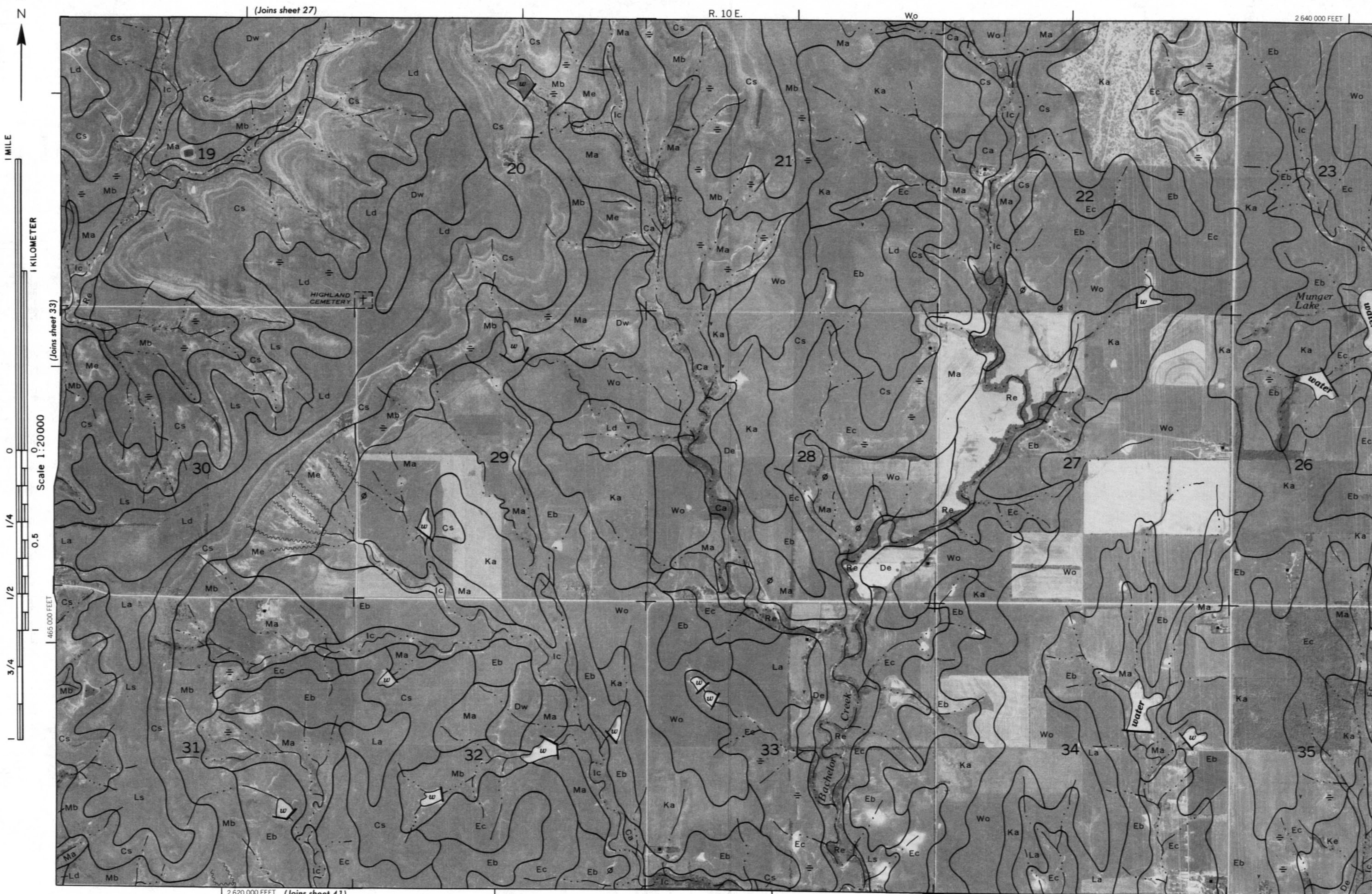
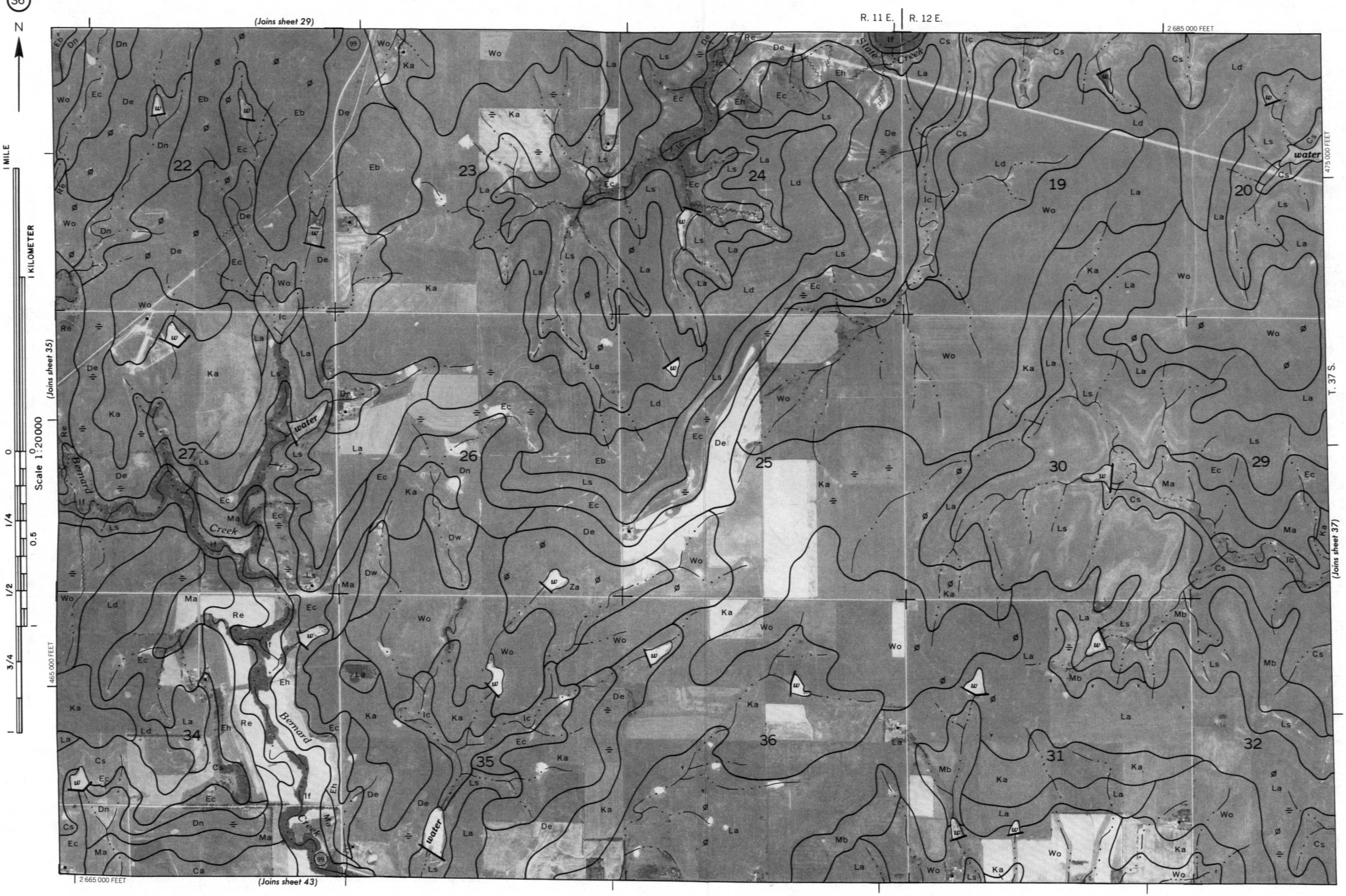



35
N
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 34)
(Joins sheet 42)
2 645 000 FEET
2 660 000 FEET
475 000 FEET
465 000 FEET
R. 10 E.
R. 11 E.
T. 24 S.
Munger Lake
Homer Creek
Bernard Creek
HOMER CREEK CEMETERY
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 36



SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 37

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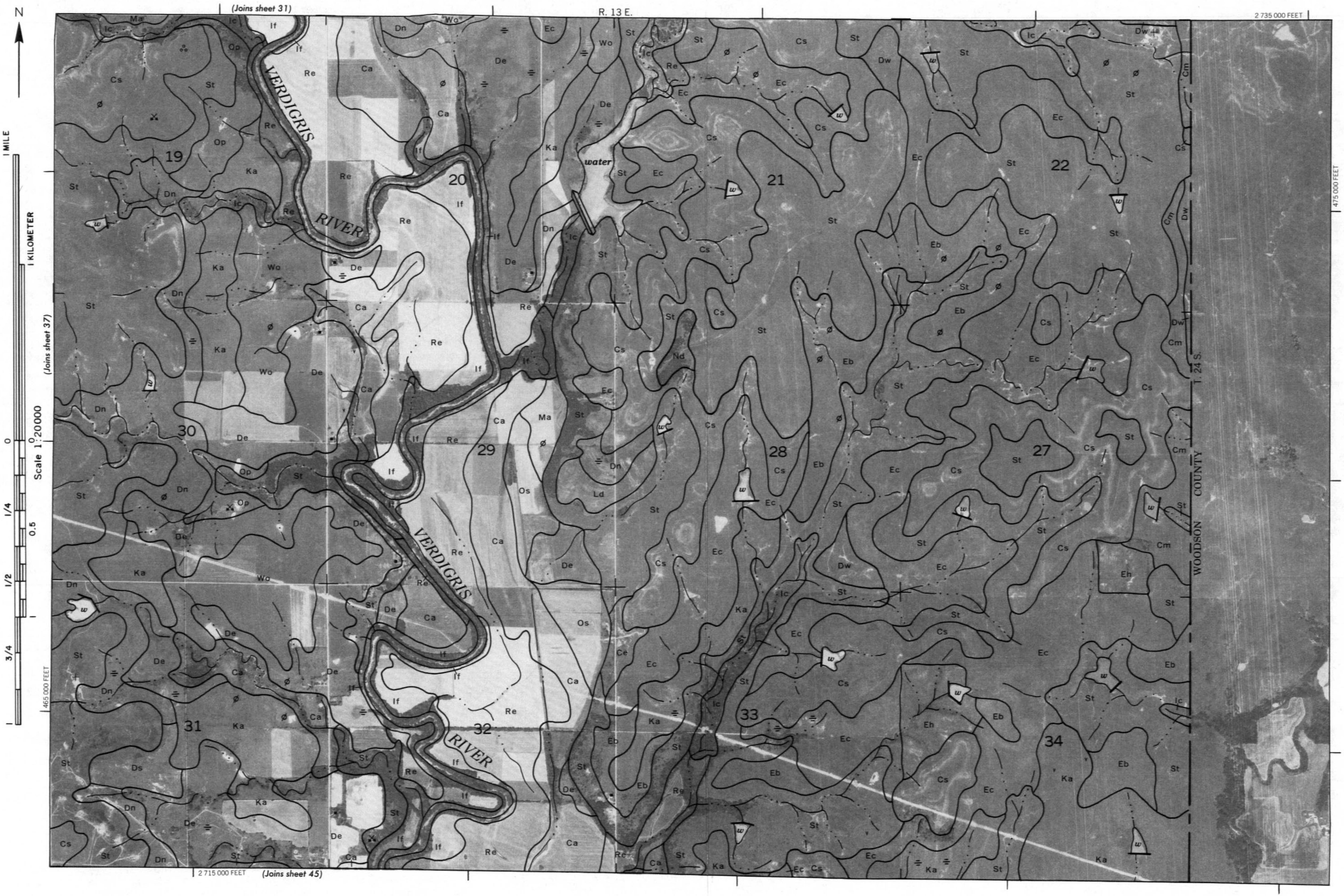
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 38



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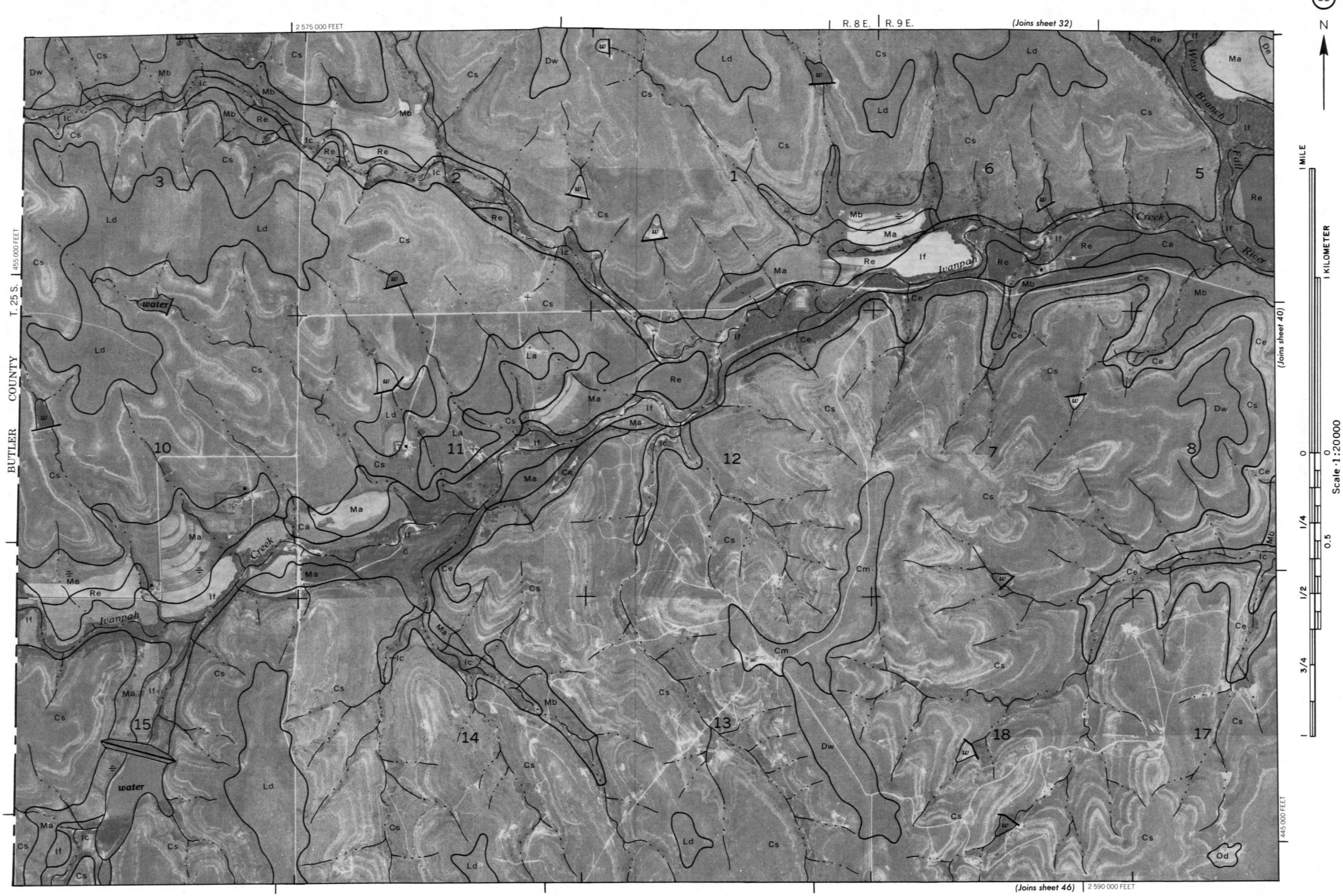

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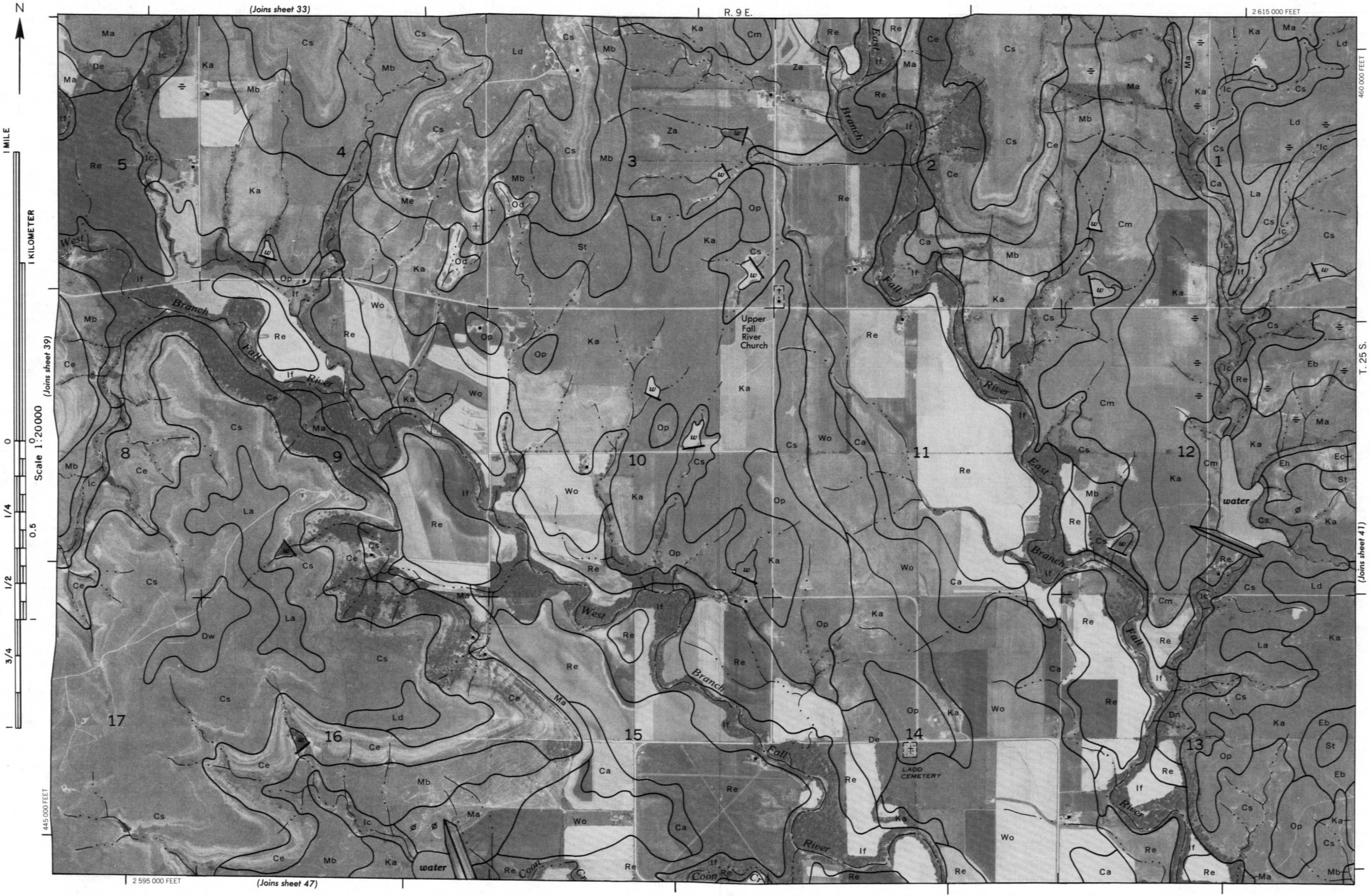
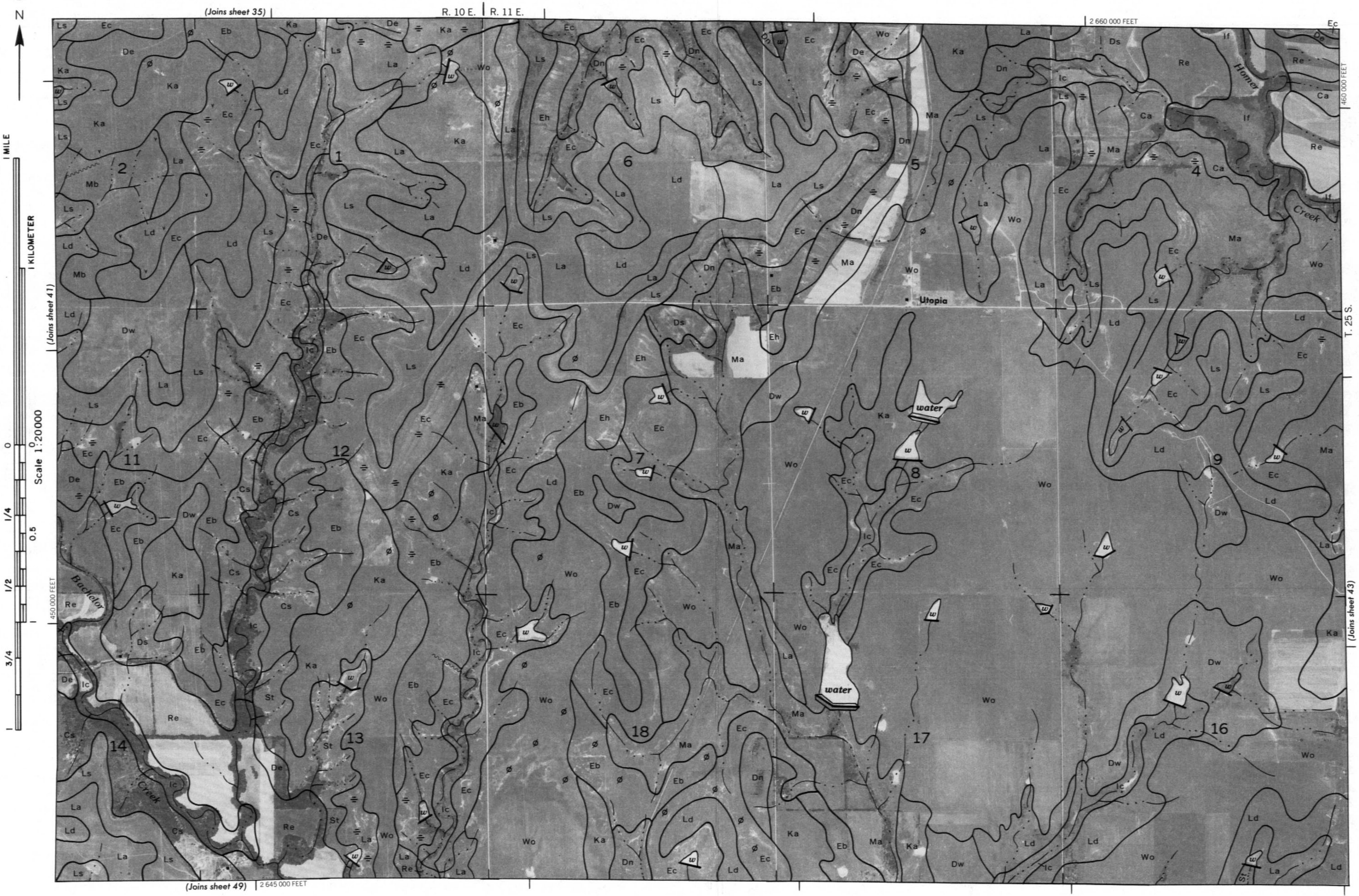
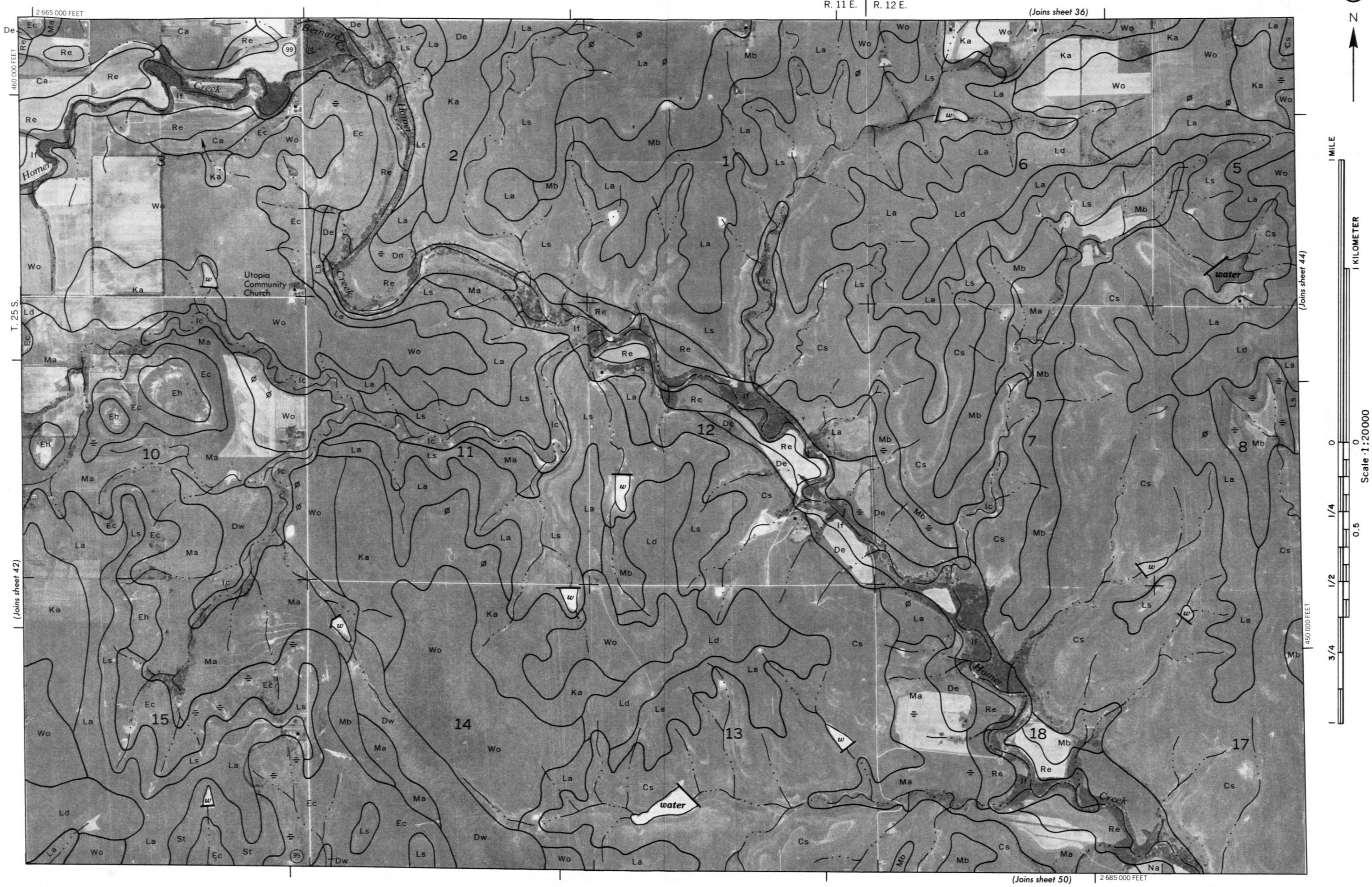


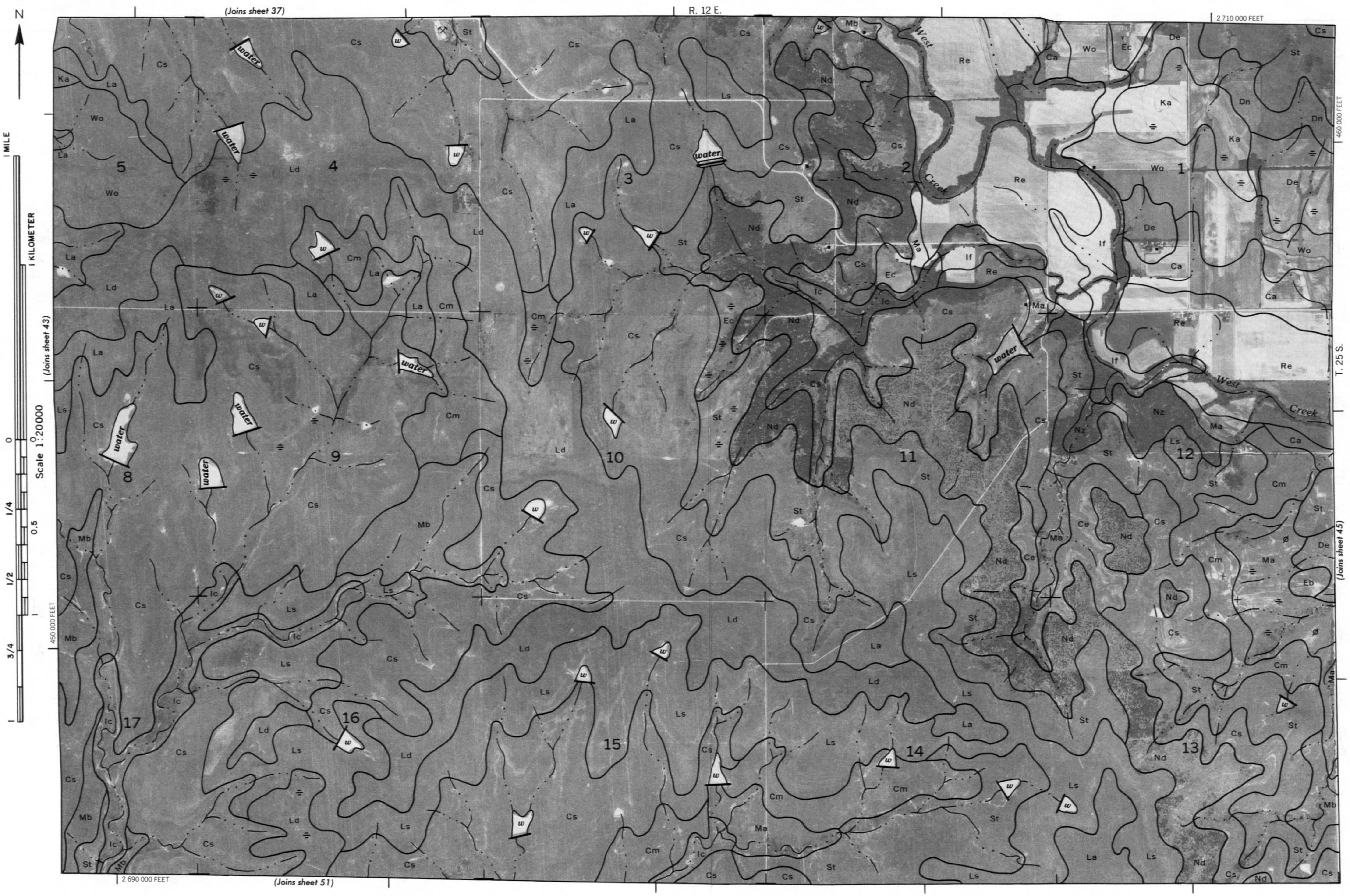
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 41

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 42



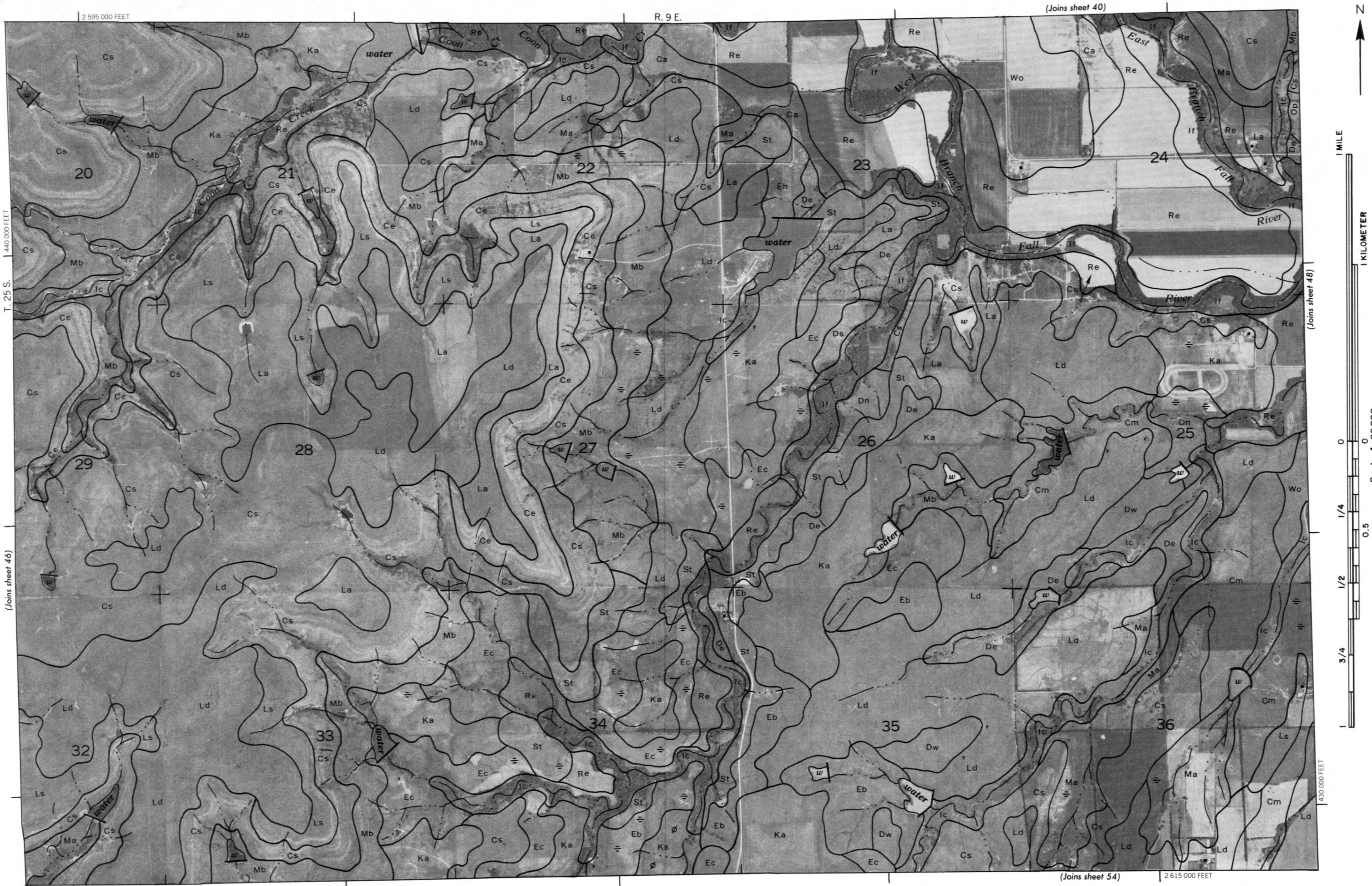

2 665 000 FEET
R. 11 E. | R. 12 E.
(Joins sheet 36)
460 000 FEET
T. 25 S.
(Joins sheet 42)
(Joins sheet 44)
450 000 FEET
(Joins sheet 50)
2 685 000 FEET
Utopia Community Church
Bernard Cr.
Homer Creek
water
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 44



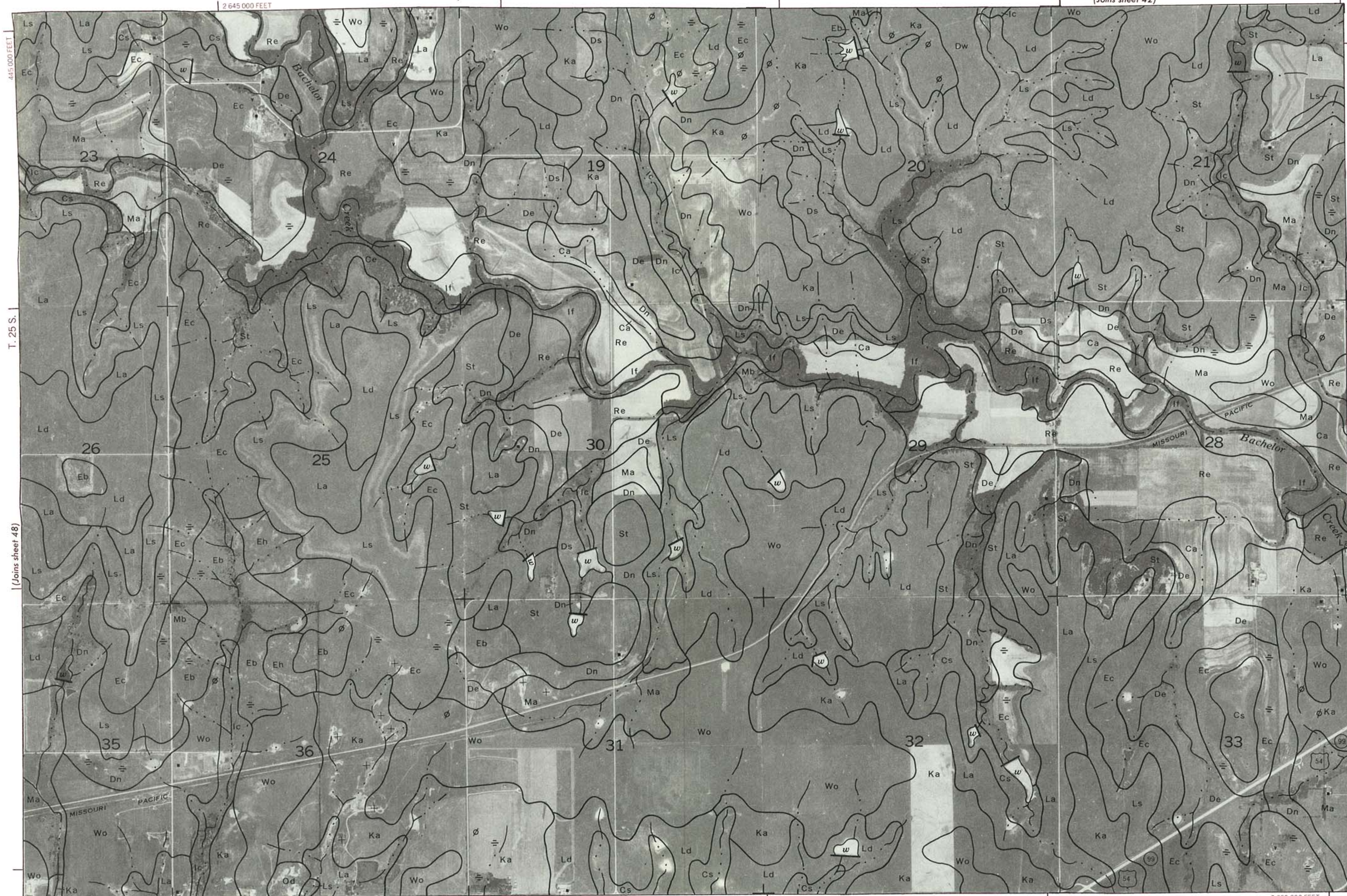

N
2 715 000 FEET
R. 13 E.
(Joins sheet 38)
460 000 FEET
T. 25 S.
(Joins sheet 44)
(Joins sheet 52)
2 735 000 FEET
450 000 FEET
PLEASANT VALLEY CEMETERY
QUINCY CEMETERY
Quincy
VERDIGRIS
RIVER
West
Creek
Dry
WOODSON COUNTY
water
3
4
5
6
7
8
9
10
15
16
17
18
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 46


(Joins sheet 40)
(Joins sheet 48)
(Joins sheet 54)
(Joins sheet 46)
R. 9 E.
T. 25 S.
2 595 000 FEET
2 615 000 FEET
440 000 FEET
430 000 FEET
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Coon Creek
West Branch
East Branch
Fall River
water

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 48

49



N

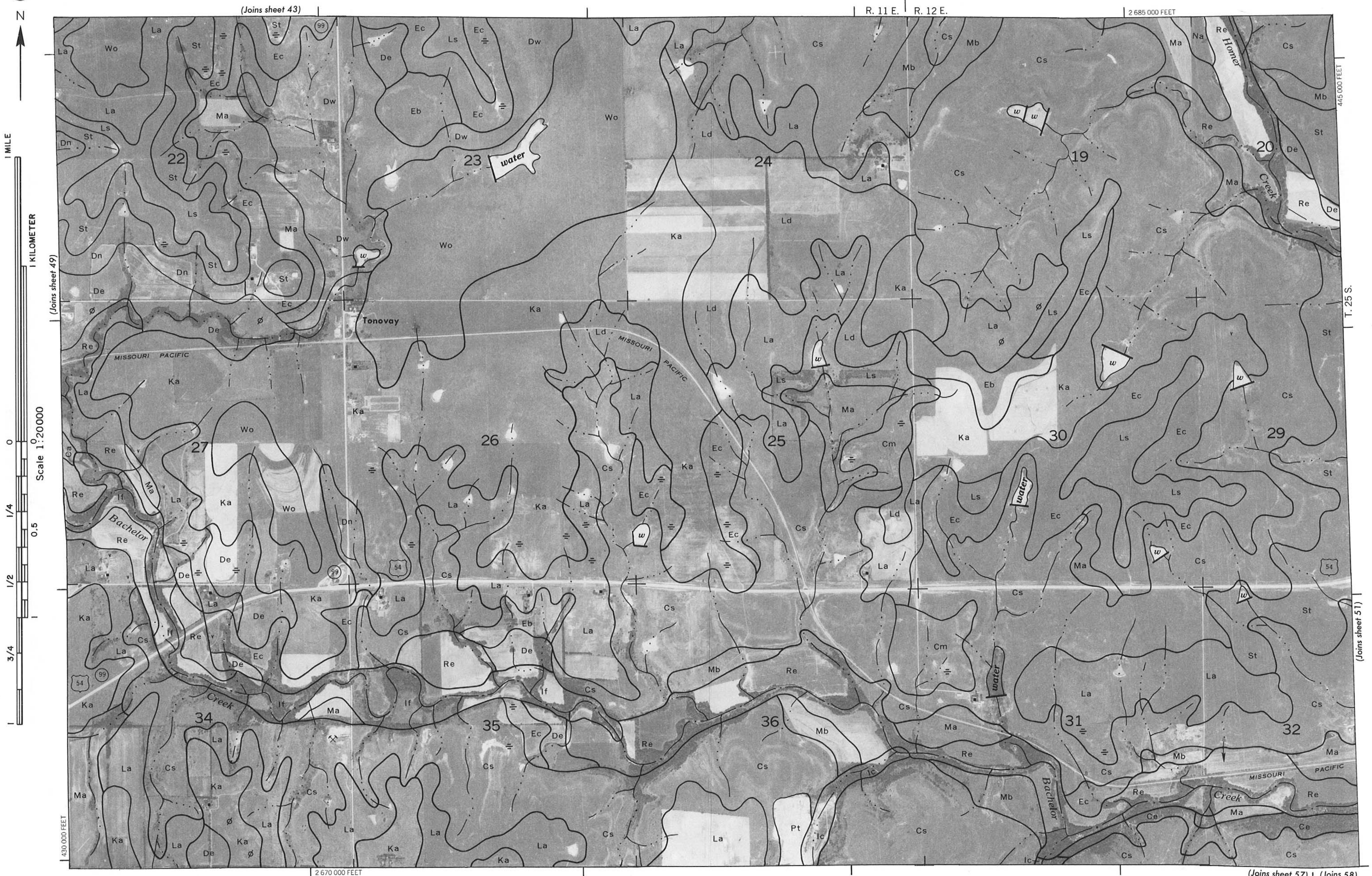
1 MILE
1 KILOMETER
0 1/4 1/2 3/4 1
0 0.5 1
Scale 1:20000

GREENWOOD COUNTY, KANSAS NO. 49

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(50)

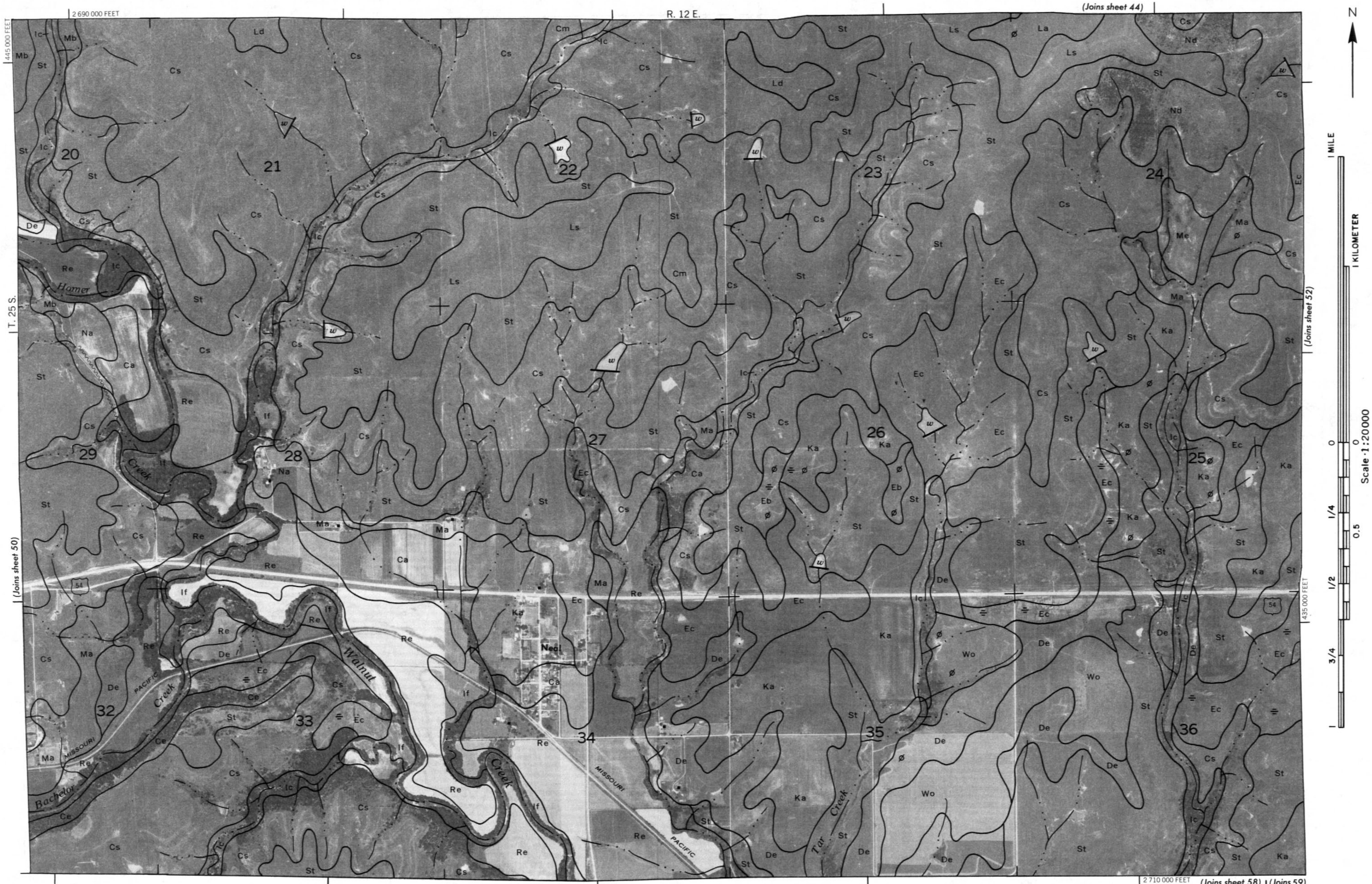
SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 50



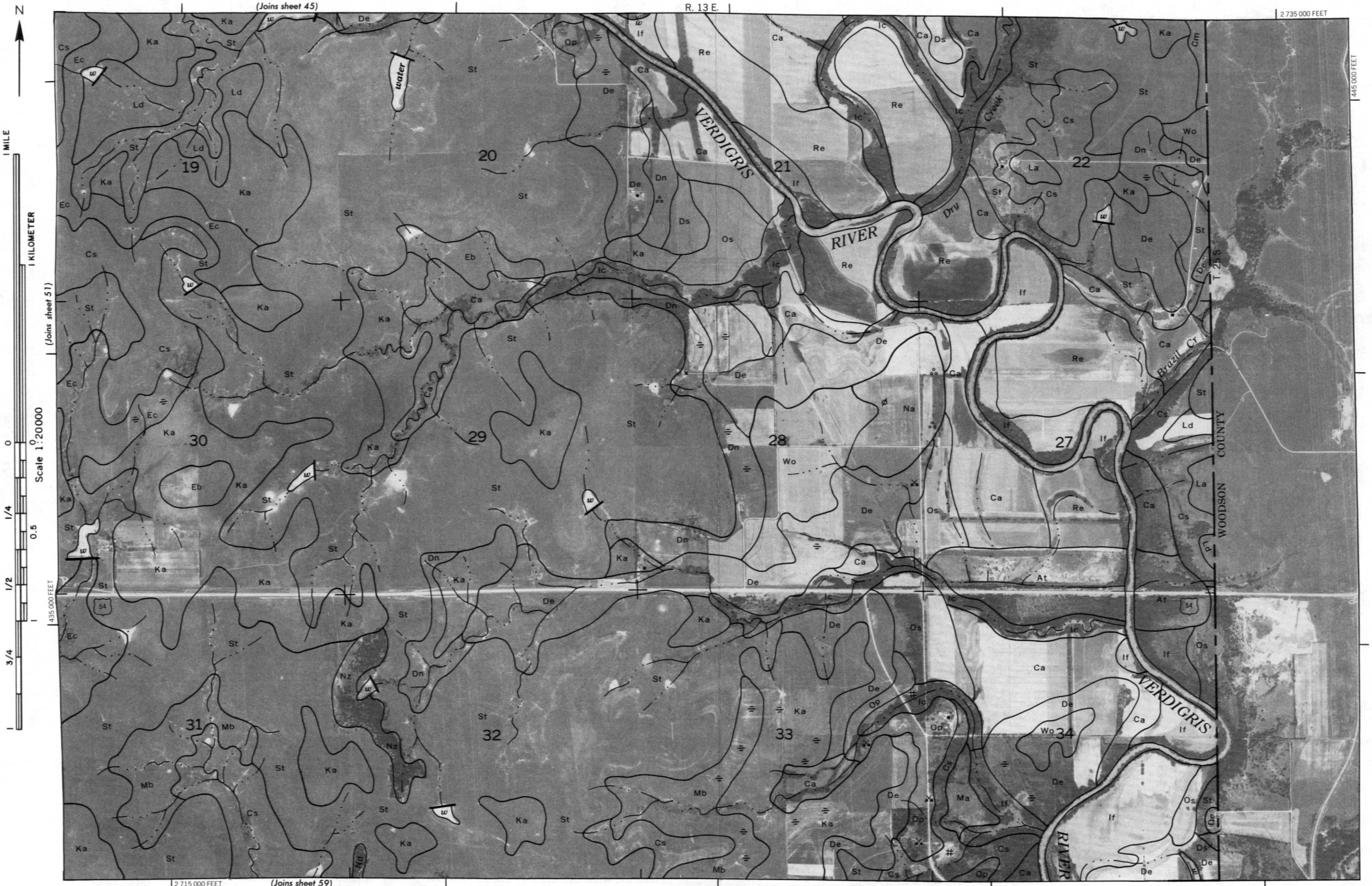
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

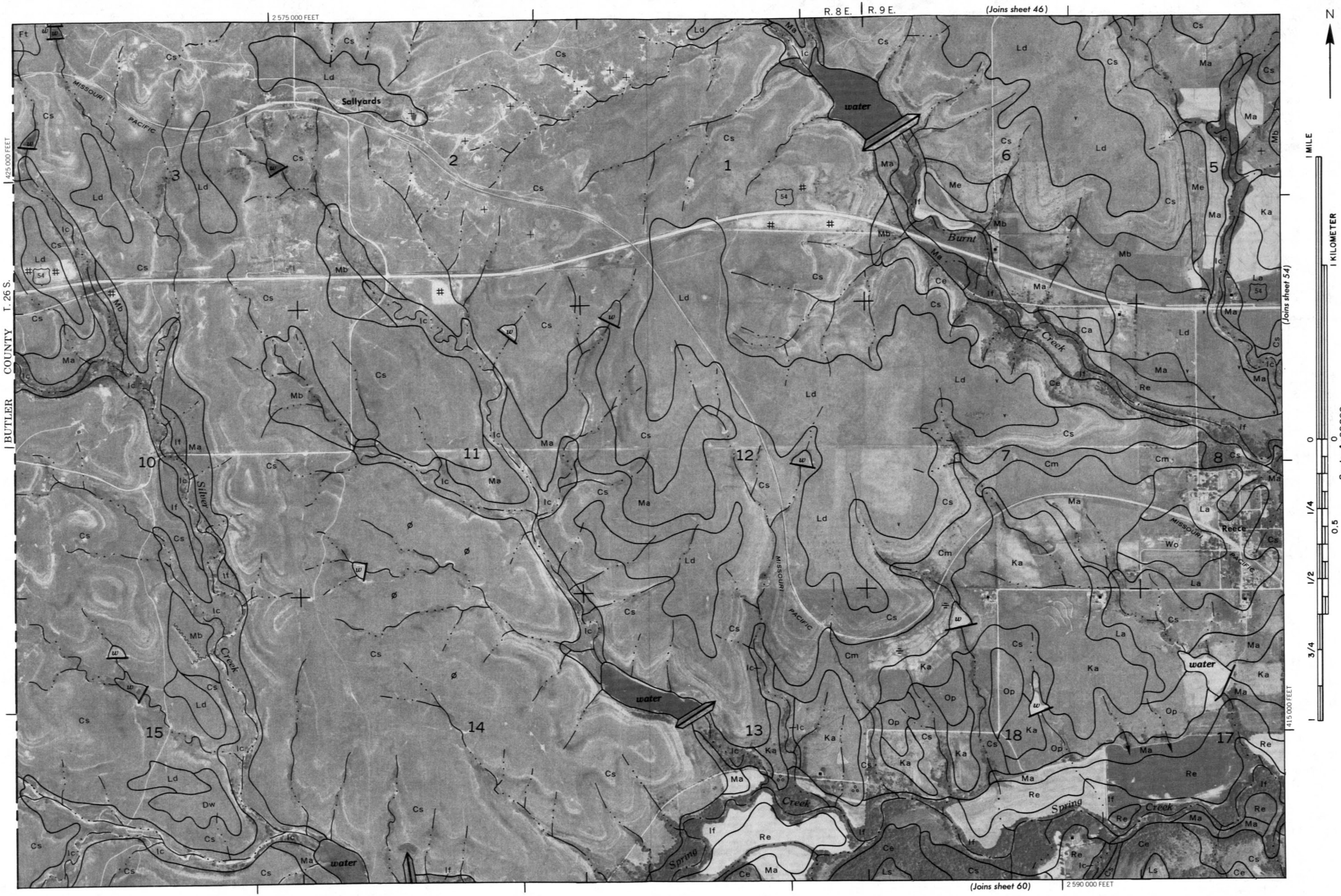
GREENWOOD COUNTY, KANSAS NO. 50

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 51

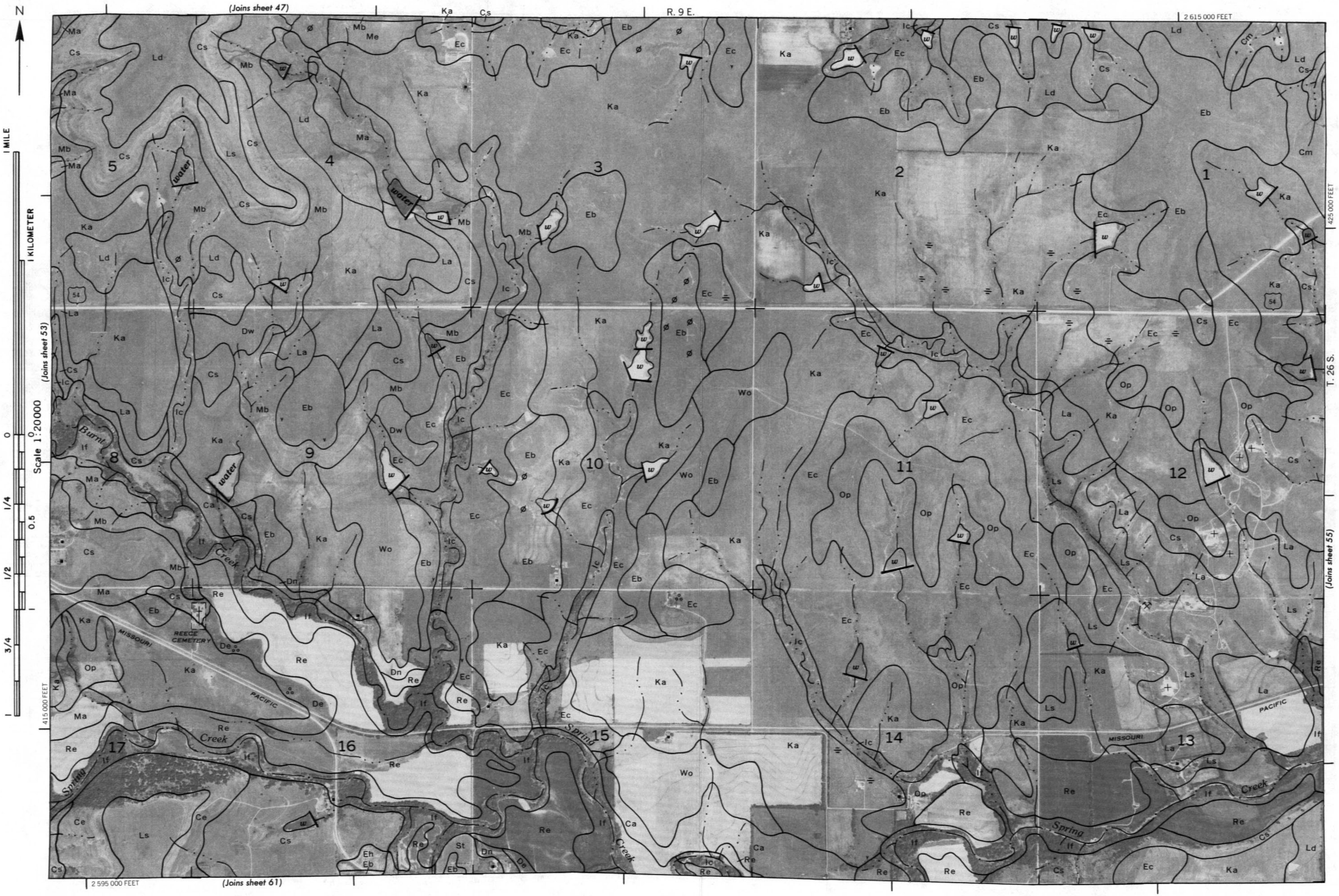


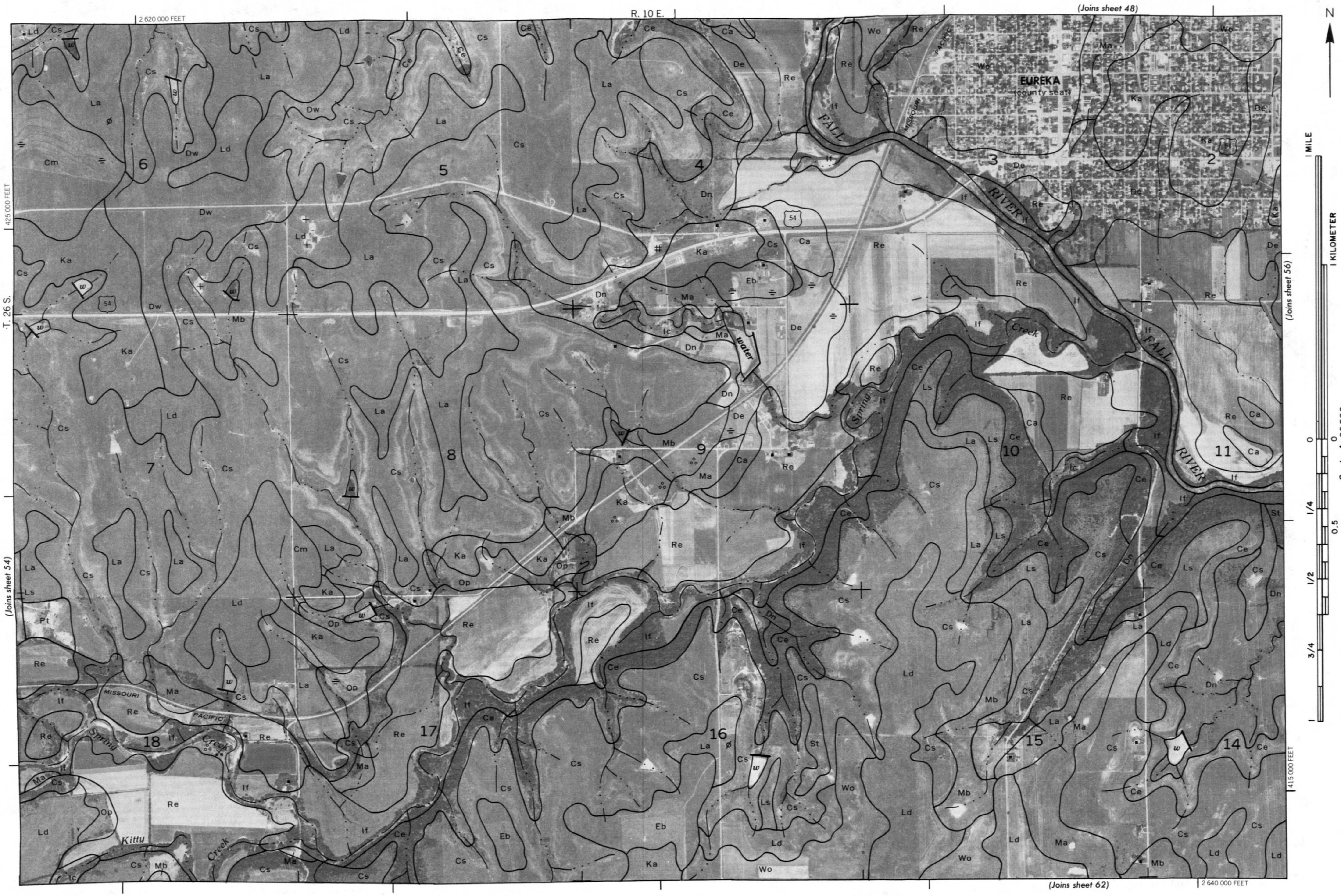
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 52




2 575 000 FEET
R. 8 E.
R. 9 E.
(Joins sheet 46)
(Joins sheet 54)
(Joins sheet 60)
2 590 000 FEET
425 000 FEET
415 000 FEET
T. 26 S.
BUTLER COUNTY
Sallyards
MISSOURI PACIFIC
Burnt Creek
Silver Creek
Spring Creek
Reece
water
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 54



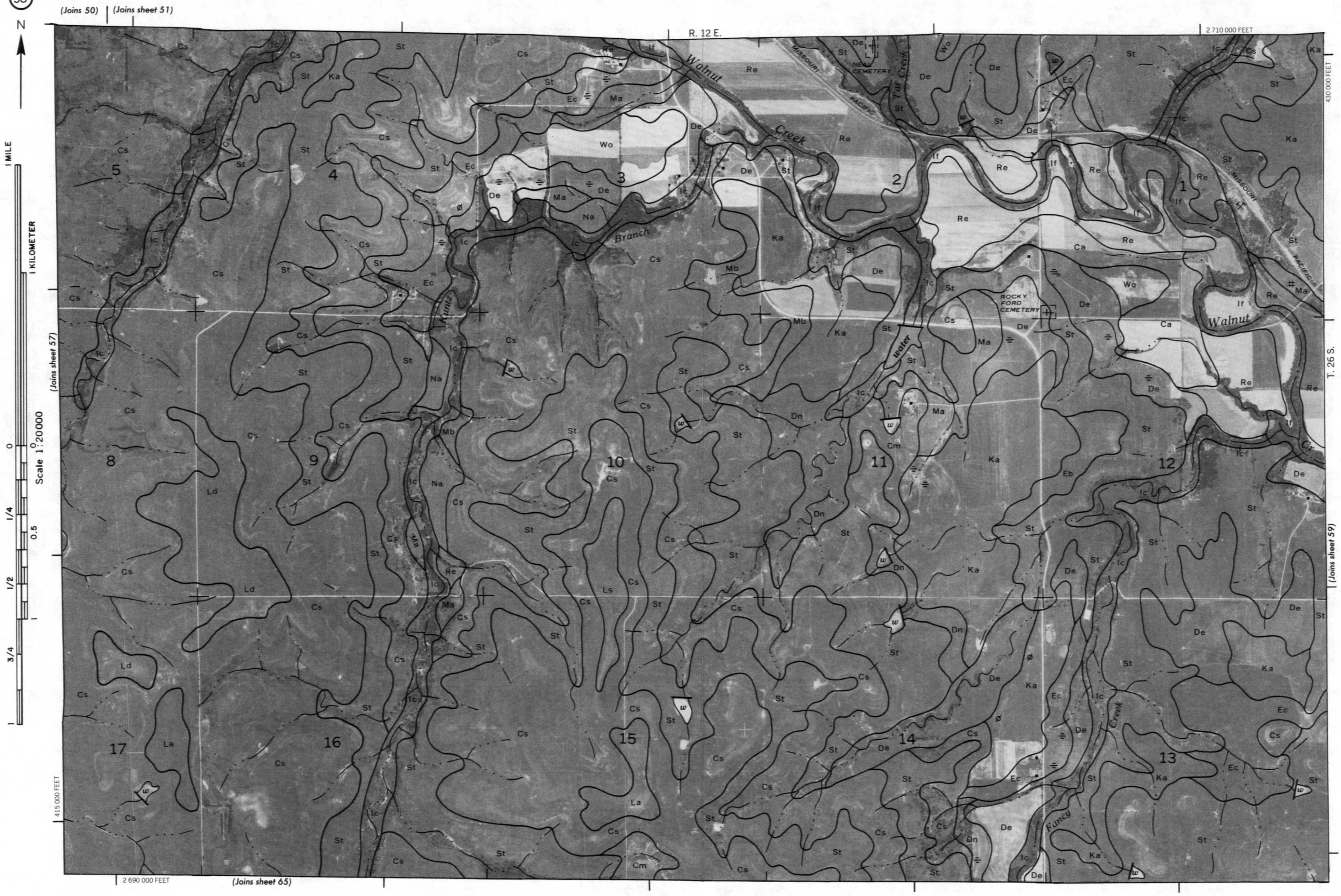

55
N
R. 10 E.
2 620 000 FEET
(Joins sheet 48)
T. 26 S.
425 000 FEET
(Joins sheet 54)
(Joins sheet 56)
415 000 FEET
(Joins sheet 62)
2 640 000 FEET
EUREKA
(county seat)
FALL RIVER
Spring Creek
Kitty Creek
MISSOURI PACIFIC
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

56

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 56

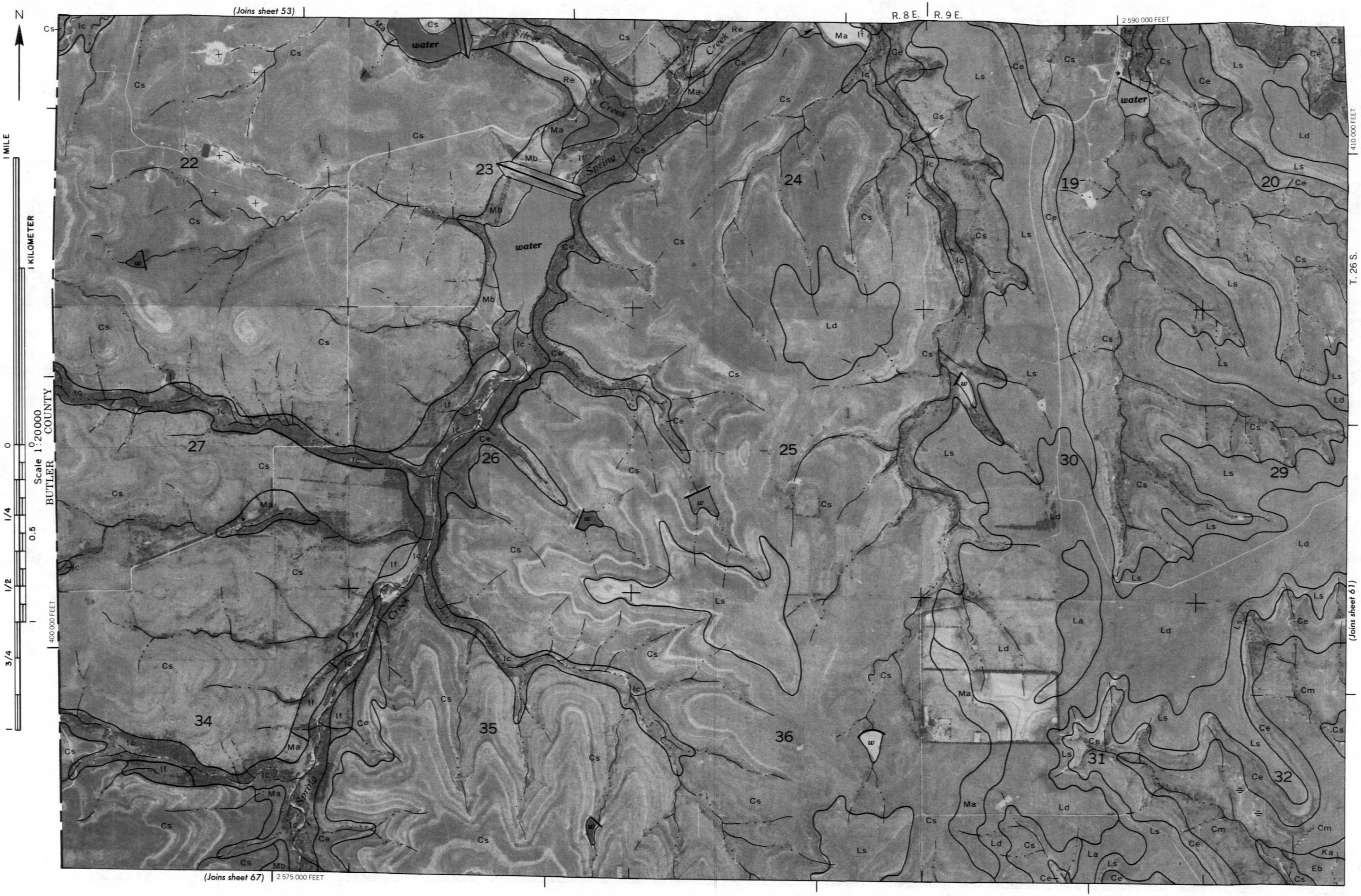
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 57

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 58



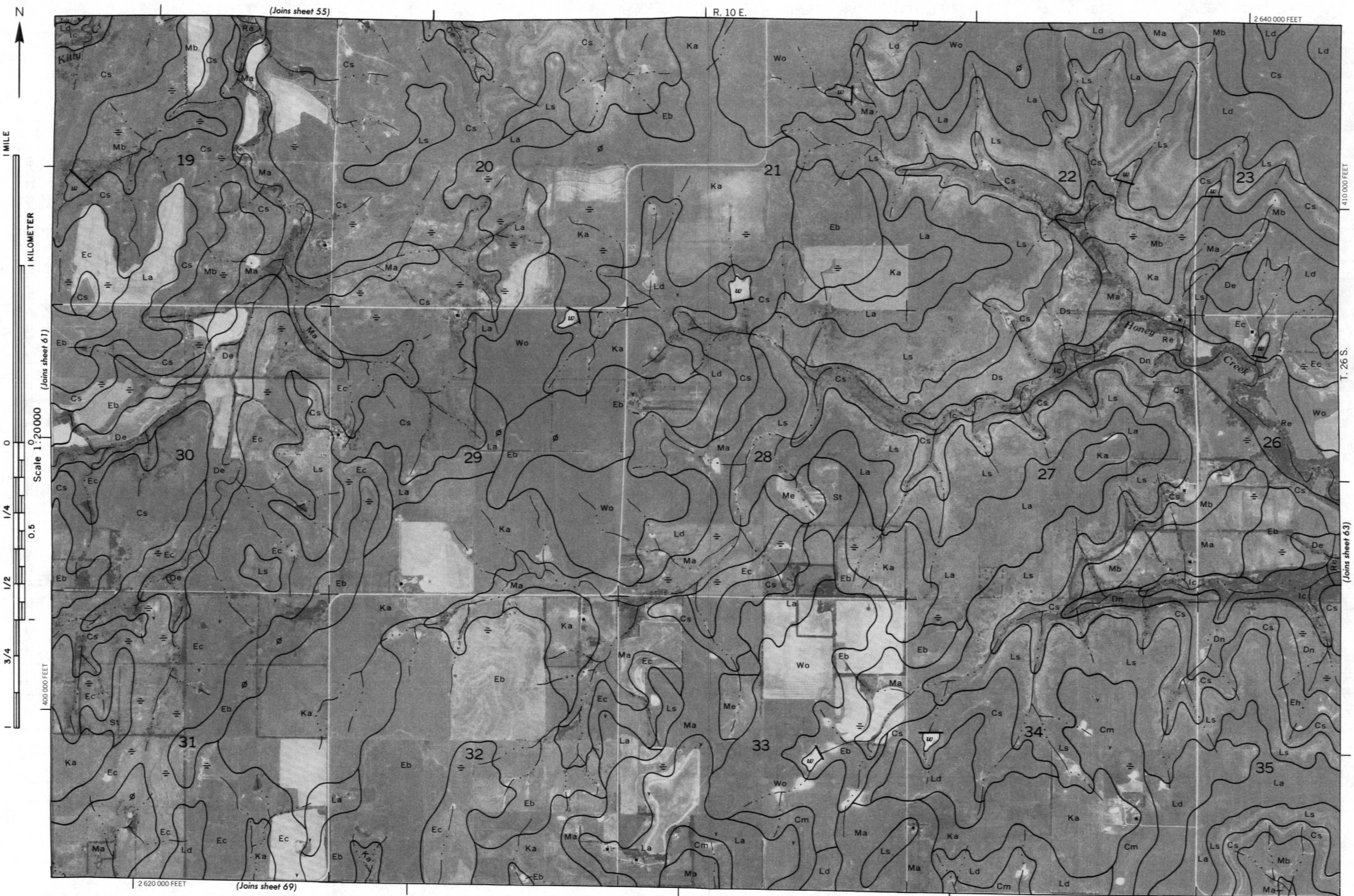

(51)
(Joins sheet 52)
2 715 000 FEET
R. 13 E.
430 000 FEET
T. 26 S.
MISSOURI PACIFIC
Walnut Creek
VERDIGRIS RIV
TORONTO RESERVOIR
WOODSON COUNTY
(Joins sheet 58)
(Joins sheet 66)
2 735 000 FEET
415 000 FEET
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 60



SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 61

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 62



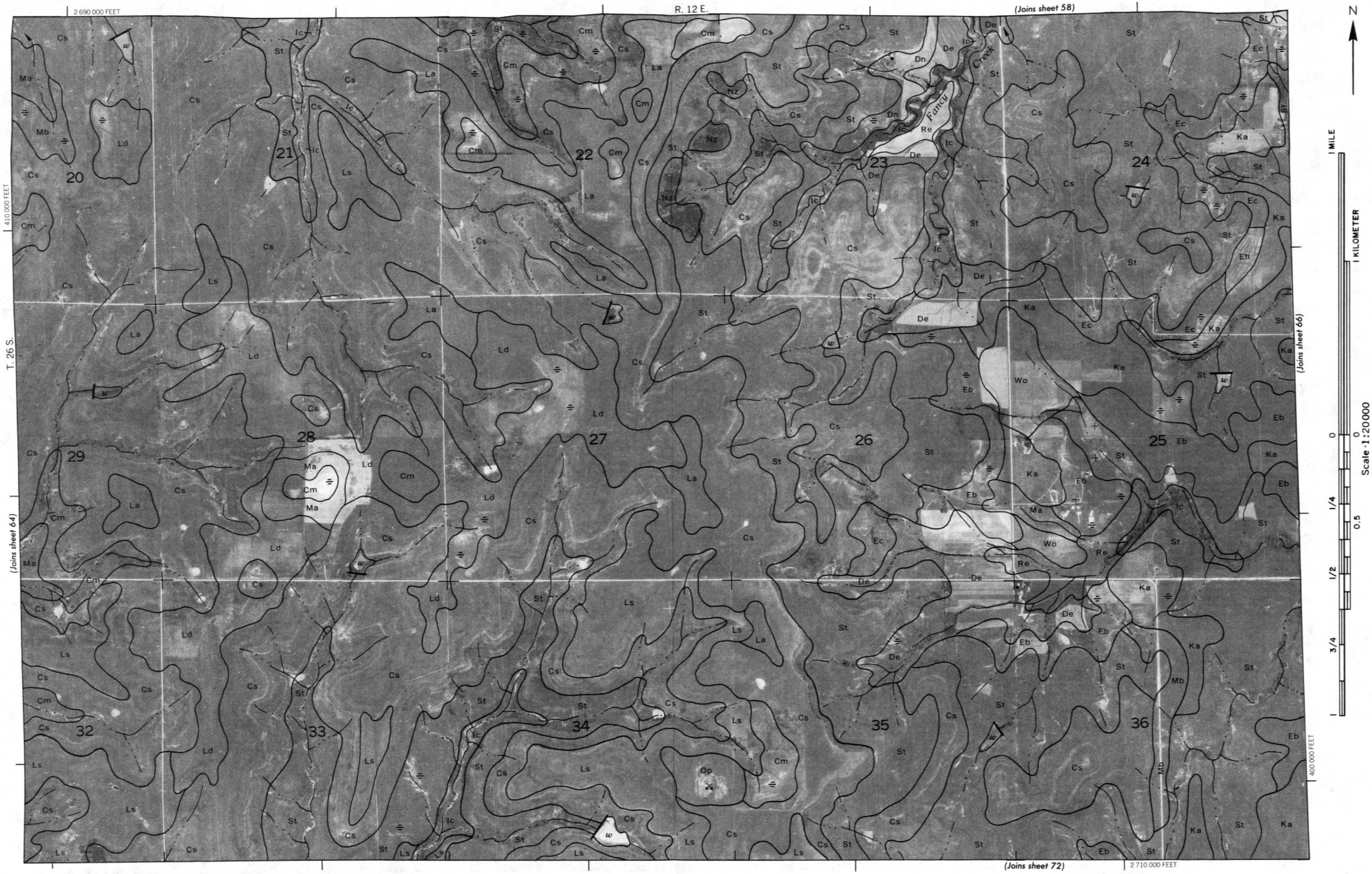
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 63

(64)

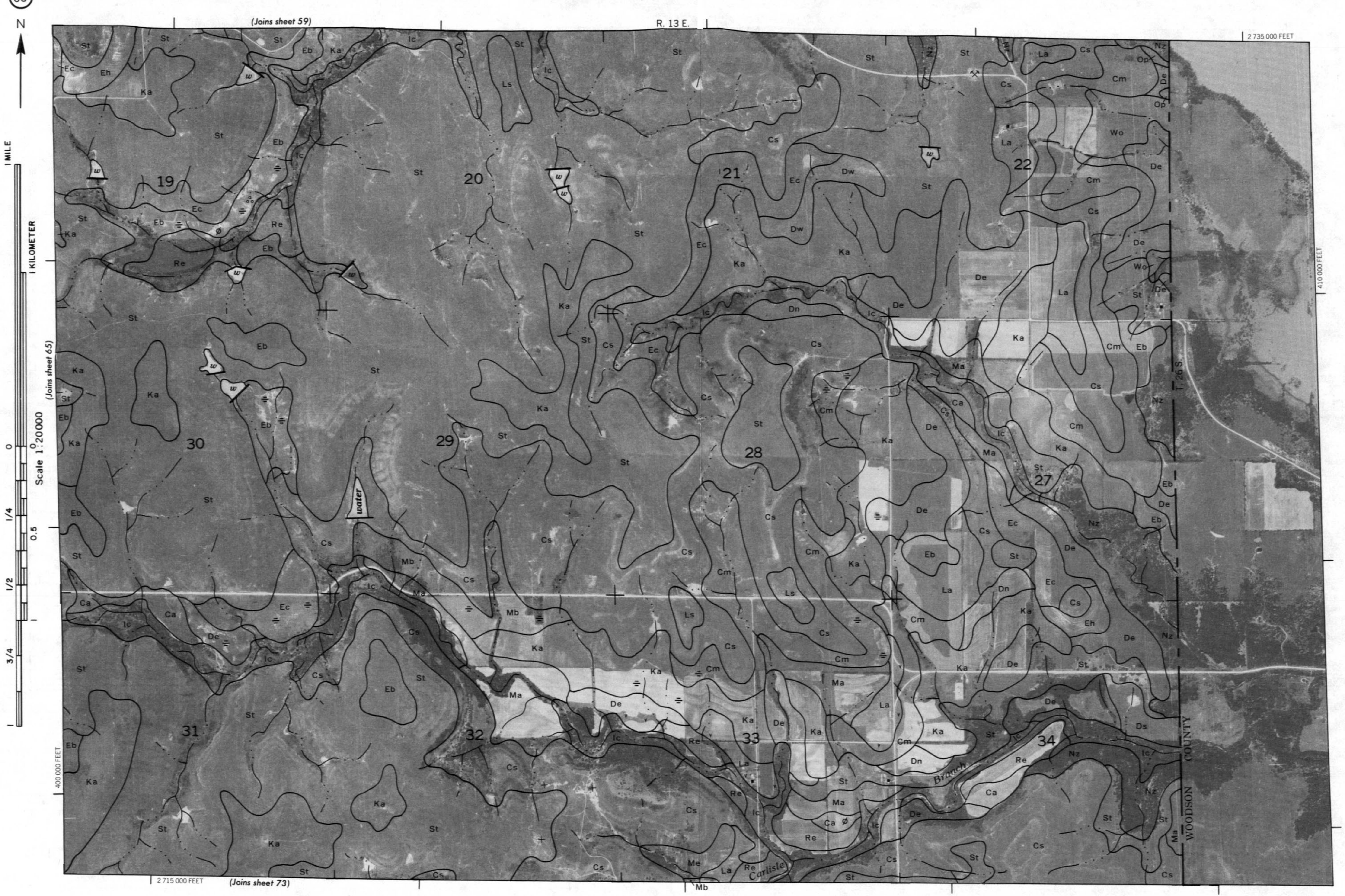
SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 64

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 65

65

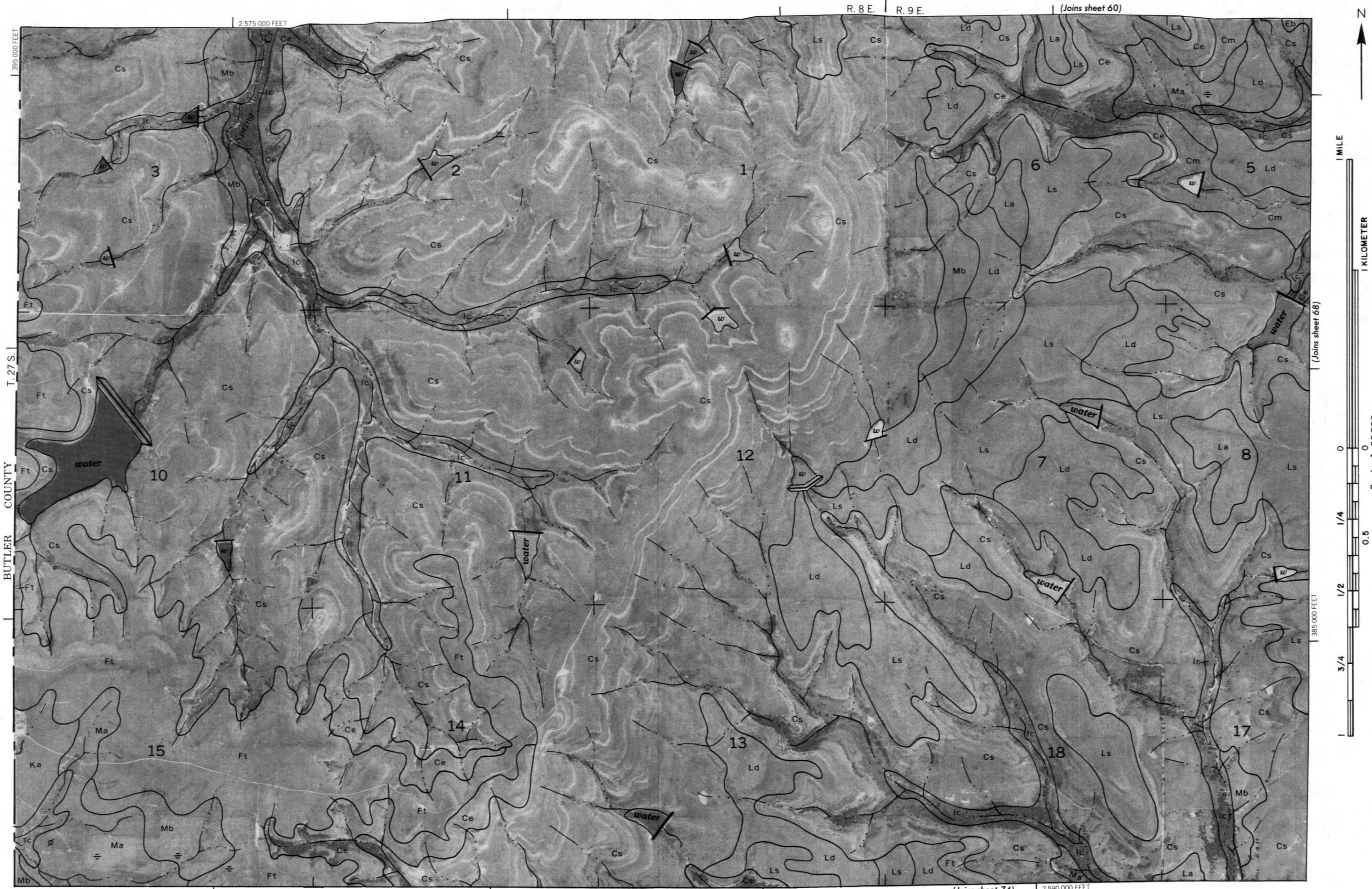


SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 66

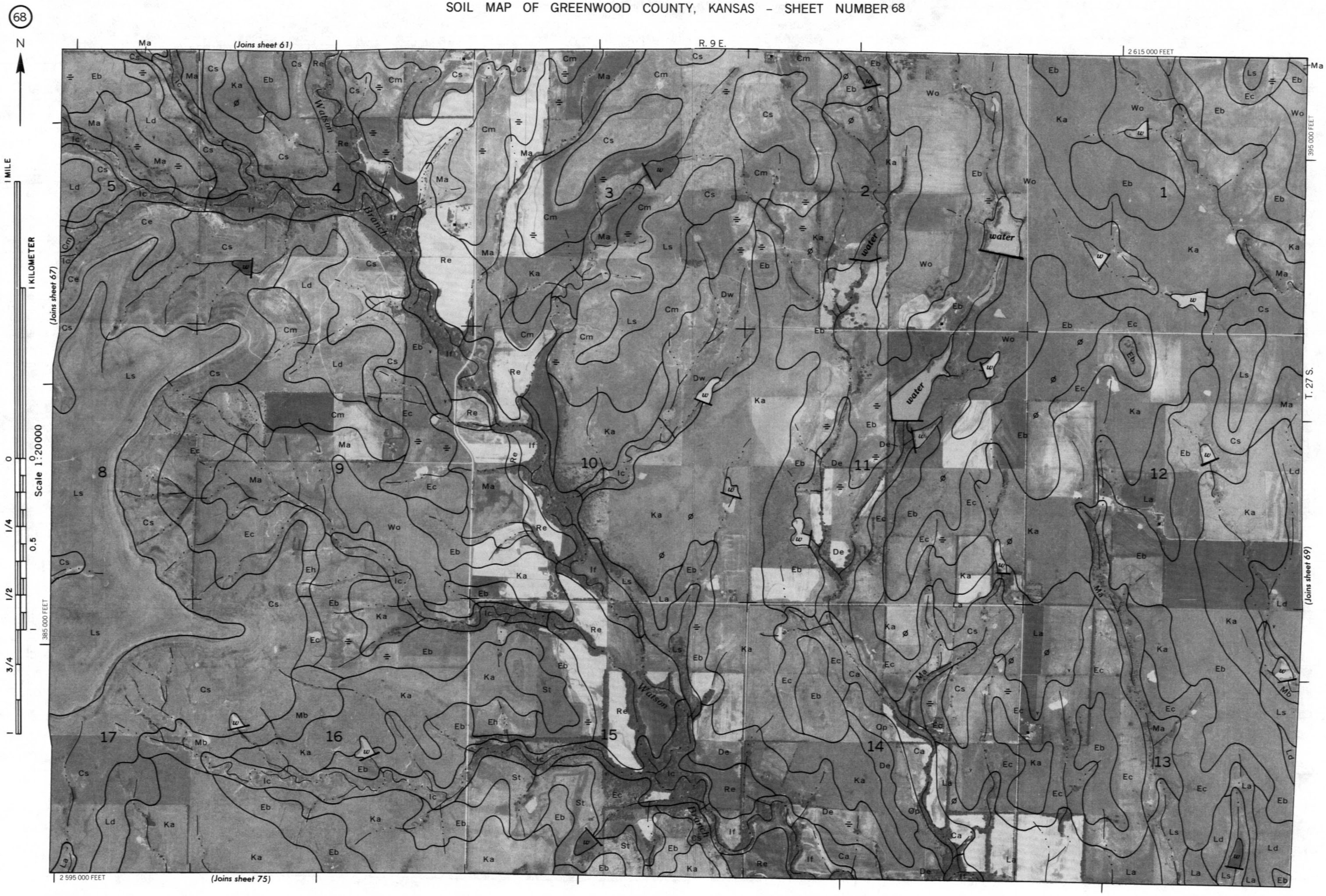


SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 67

67

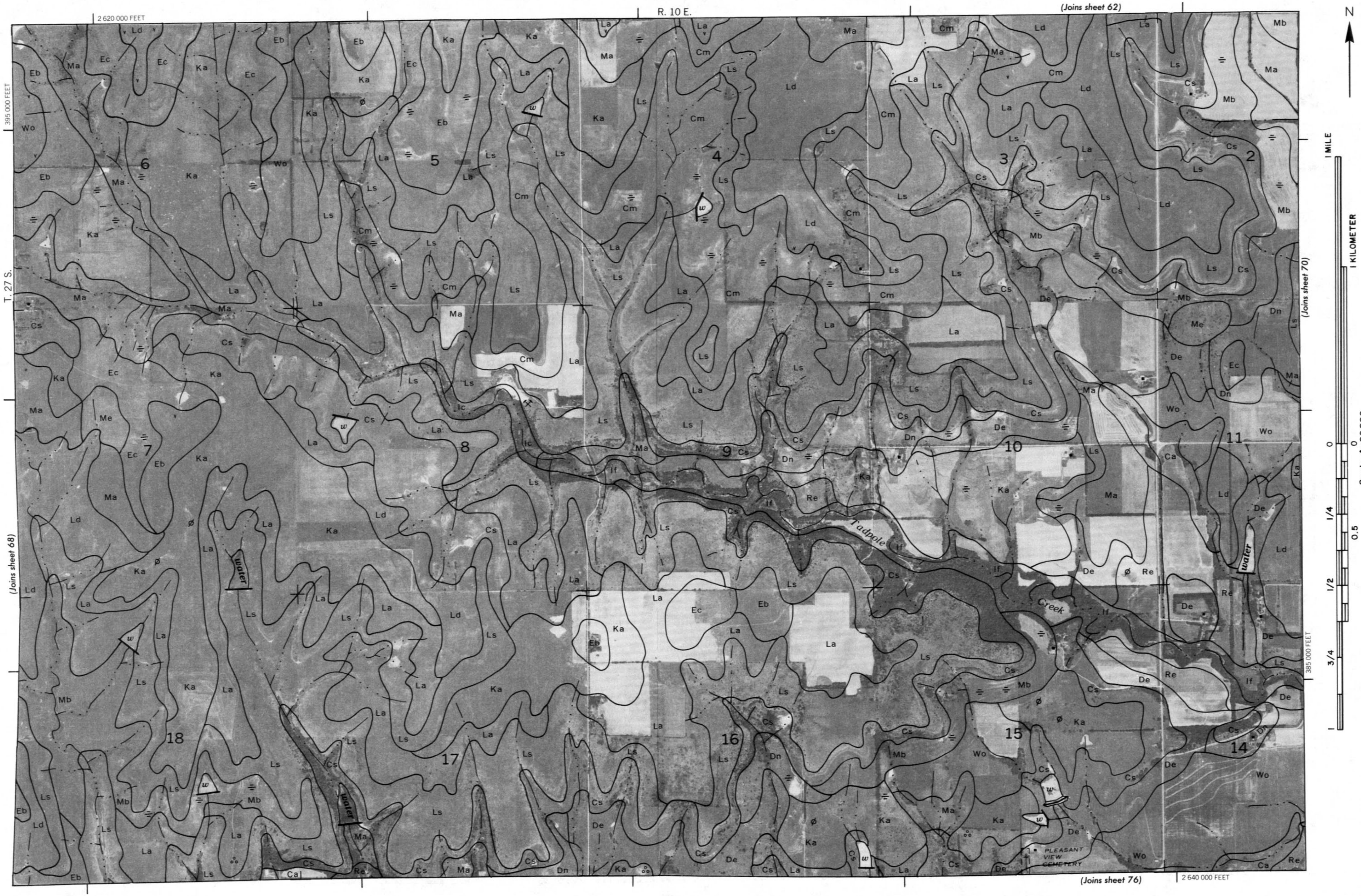


SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 68

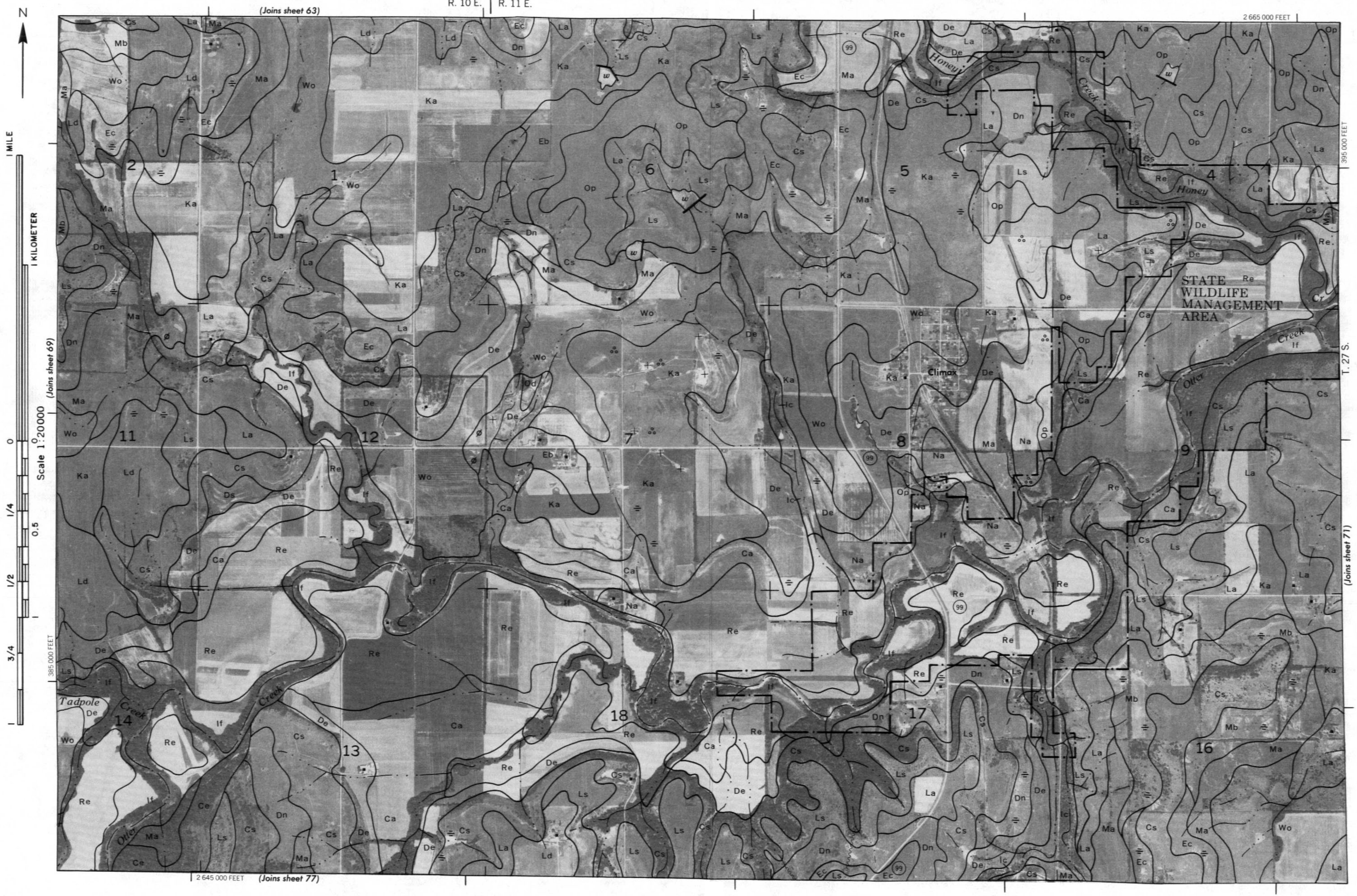


SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 69

69



SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 70

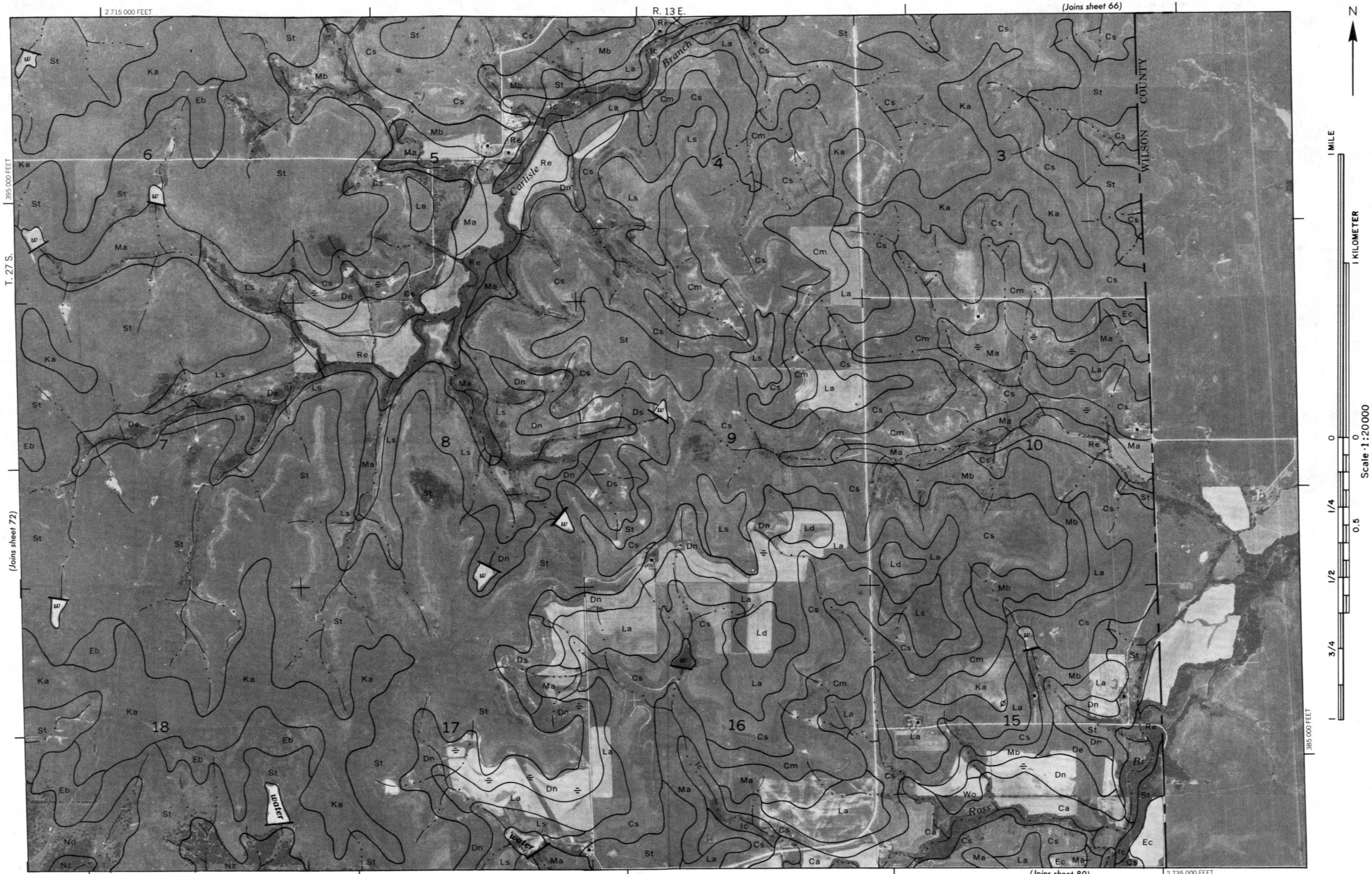


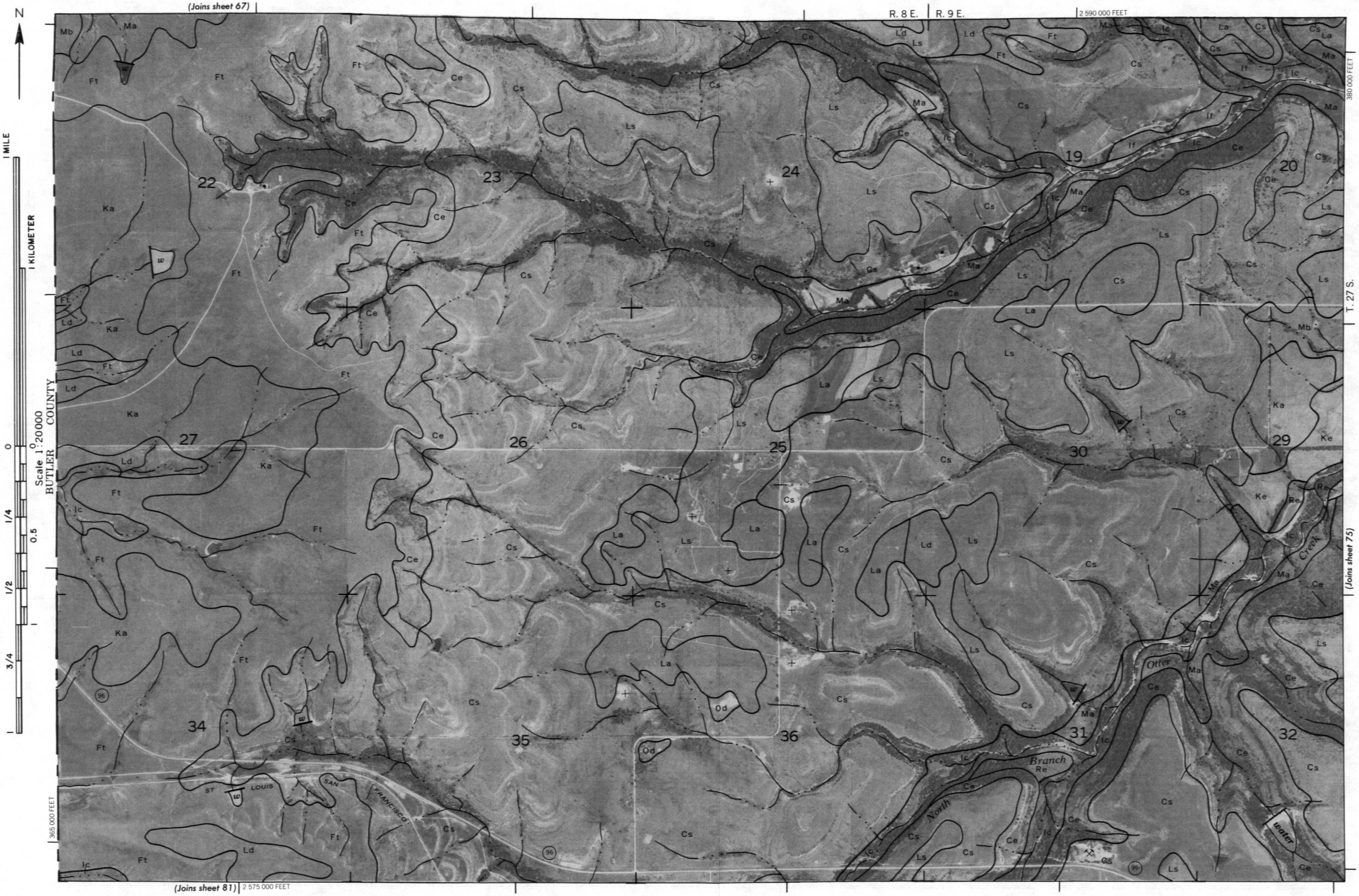
2 670 000 FEET
R. 11 E.
R. 12 E.
(Joins sheet 64)
(Joins sheet 72)
(Joins sheet 70)
(Joins sheet 78)
395 000 FEET
385 000 FEET
2 685 000 FEET
T. 27 S.
FALL
RIVER
Otter
Creek
Durham
Creek
STATE
WILDLIFE
MANAGEMENT
AREA
FALL
RIVER
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5

72

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 72

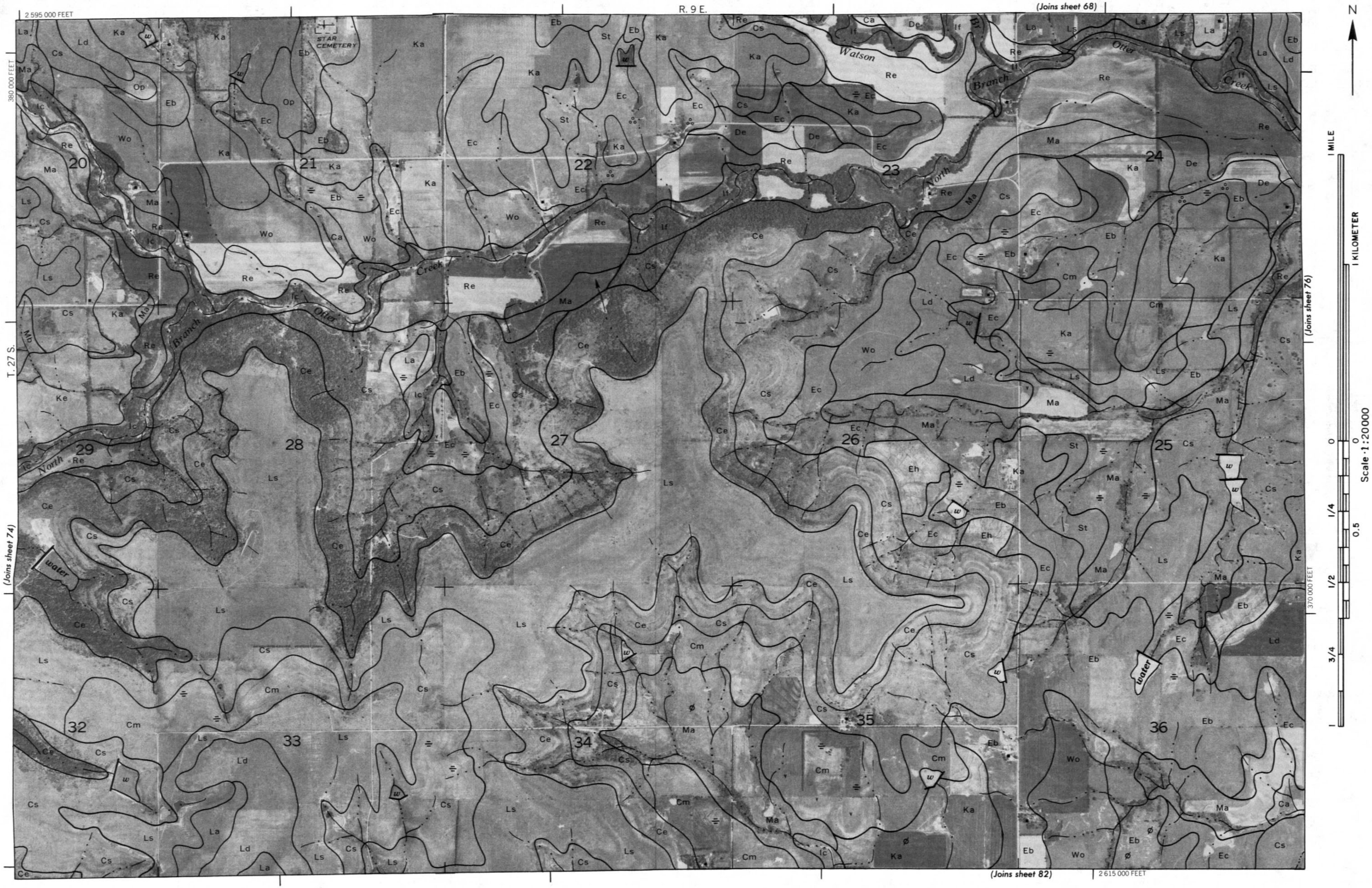
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 73




N
(Joins sheet 67)
R. 8 E.
R. 9 E.
2 590 000 FEET
380 000 FEET
T. 27 S.
(Joins sheet 75)
(Joins sheet 81)
2 575 000 FEET
365 000 FEET
BUTLER COUNTY
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
0.5
1/2
3/4
1
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36
Otter Creek
North Branch
ST LOUIS SAN FRANCISCO
96
water

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 75

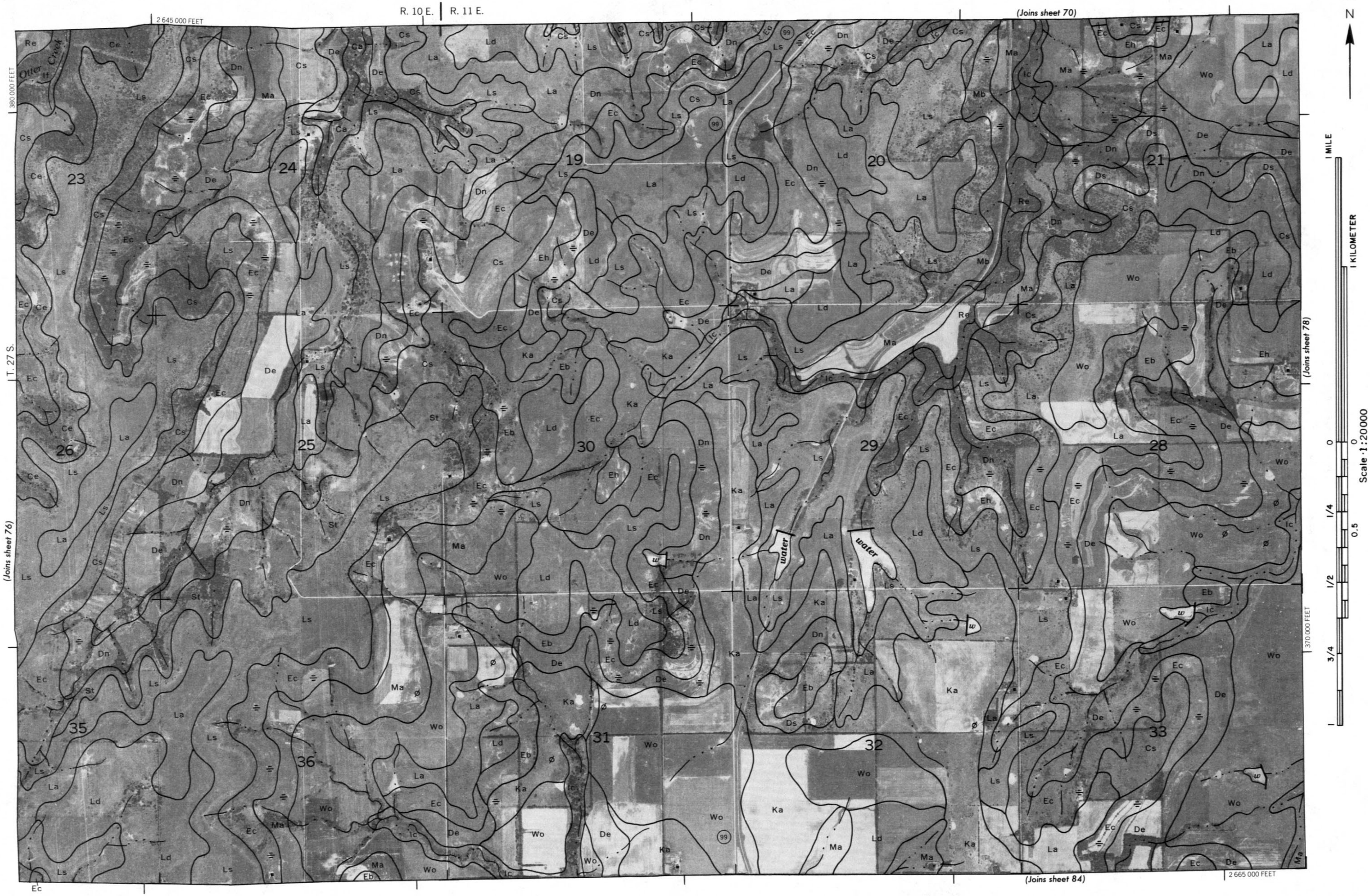
75



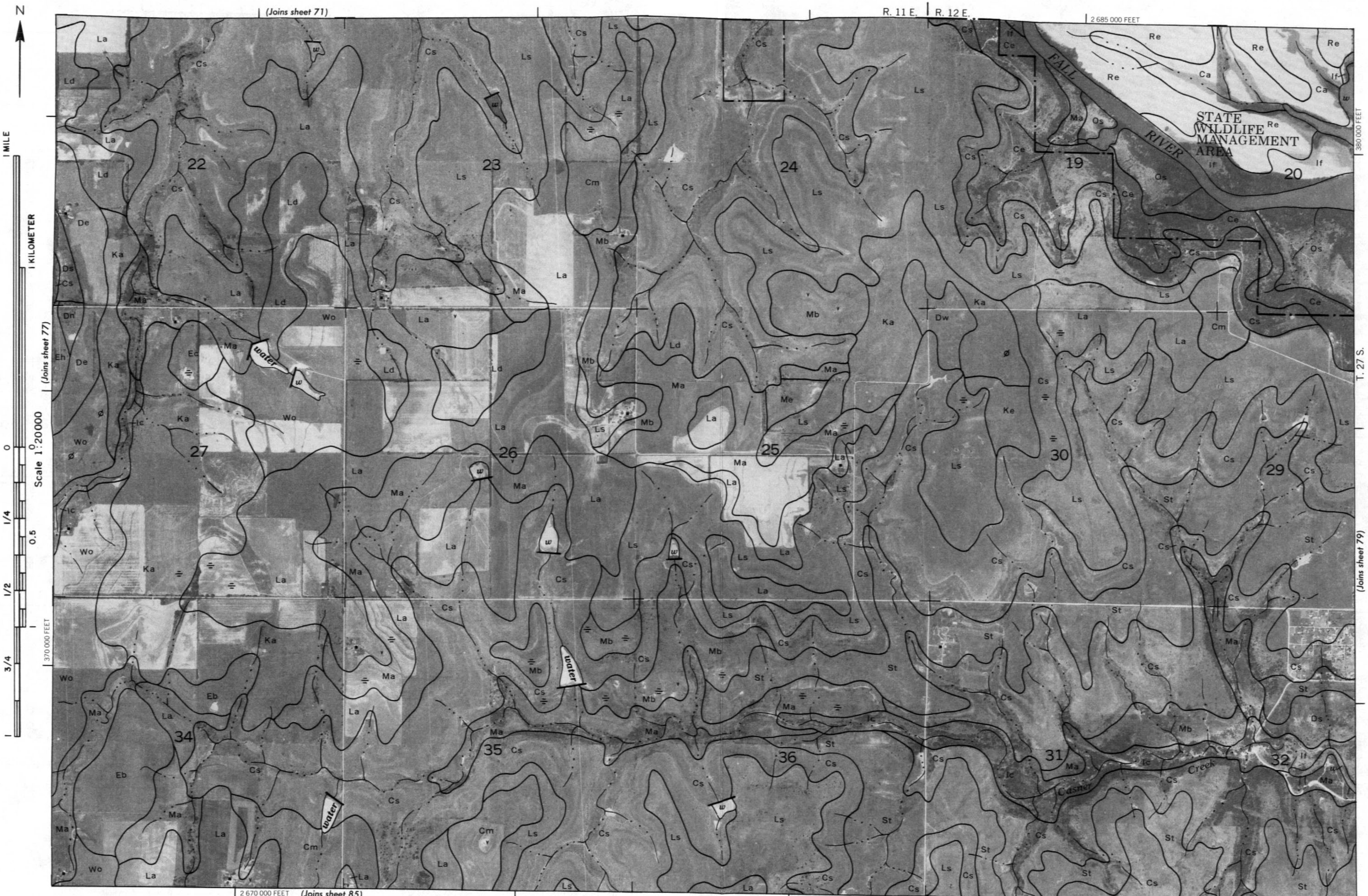
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 76

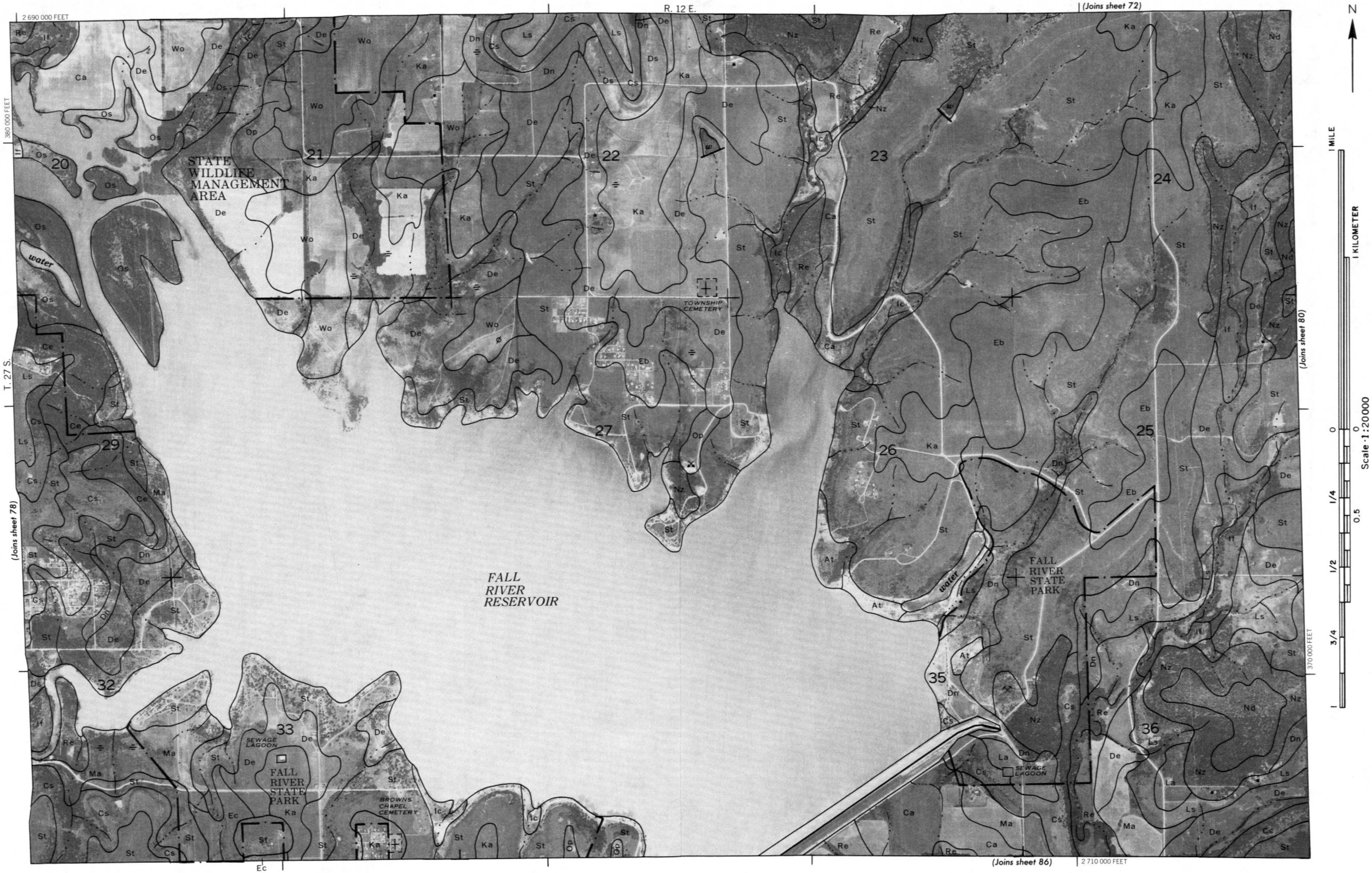
SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 77

77

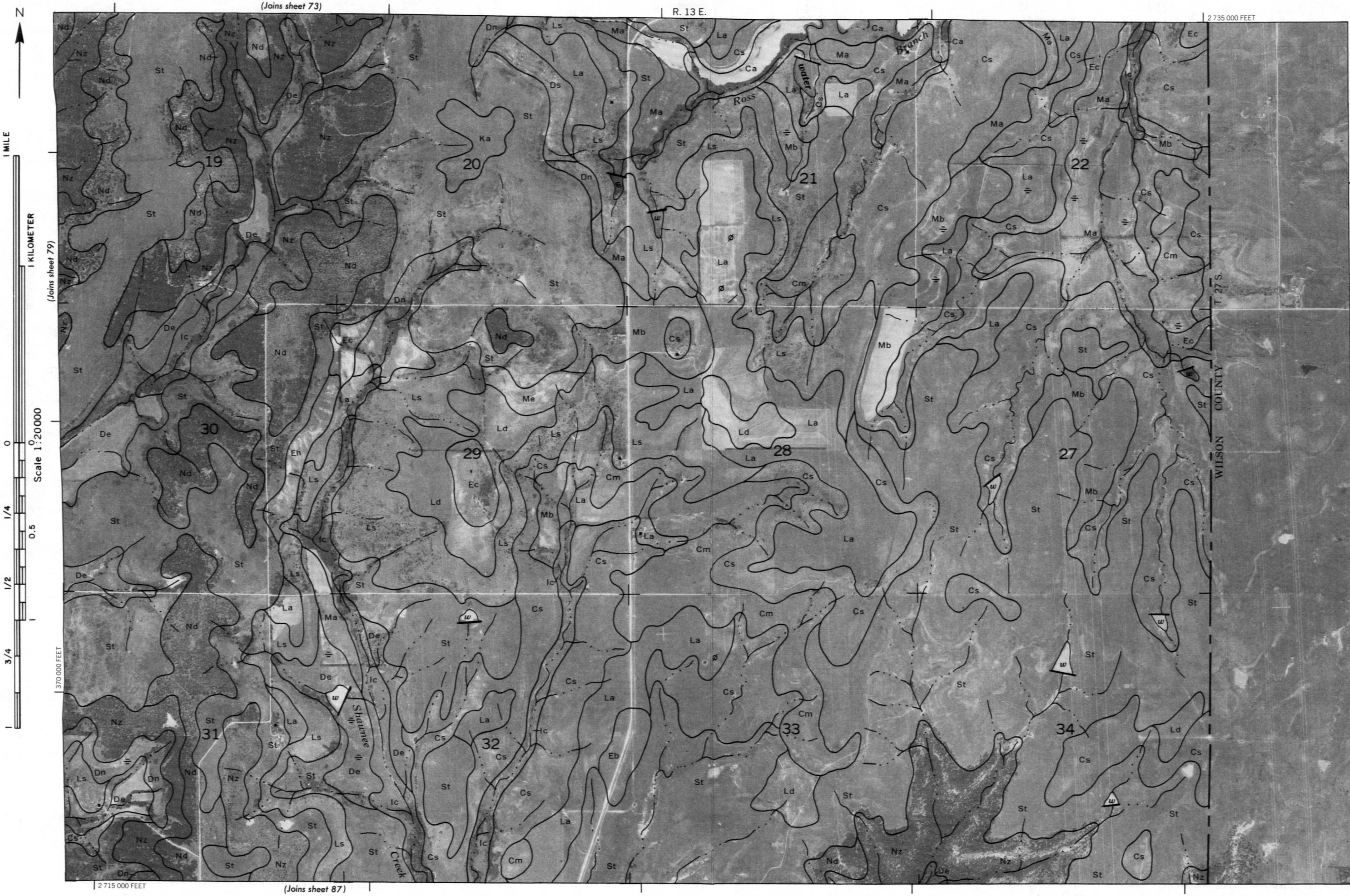


SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 78



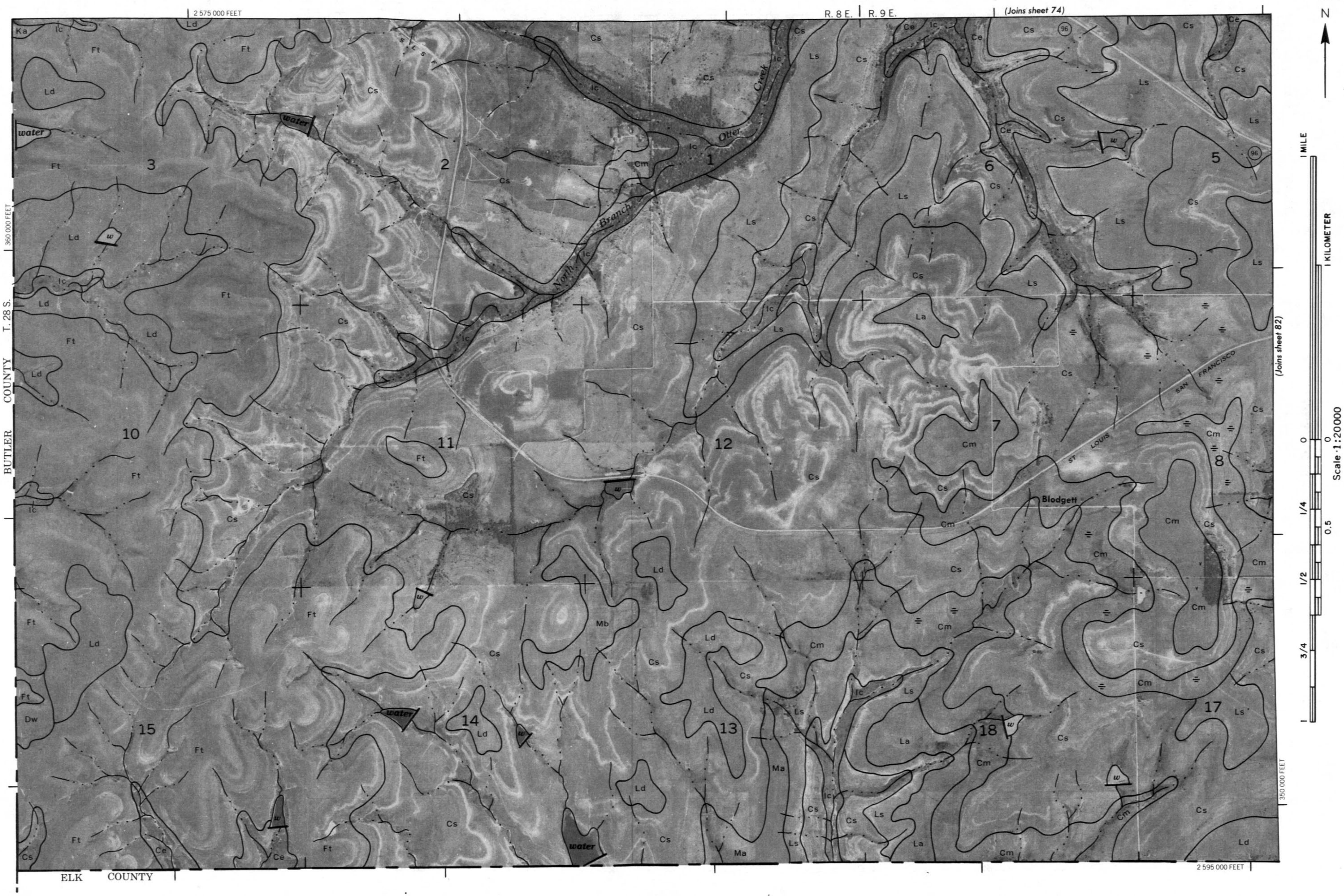

R. 12 E.
T. 27 S.
2 690 000 FEET
380 000 FEET
370 000 FEET
2 710 000 FEET
(Joins sheet 72)
(Joins sheet 78)
(Joins sheet 80)
(Joins sheet 86)
N
STATE WILDLIFE MANAGEMENT AREA
TOWNSHIP CEMETERY
FALL RIVER RESERVOIR
FALL RIVER STATE PARK
SEWAGE LAGOON
BROWNS CHAPEL CEMETERY
water
20
21
22
23
24
25
26
27
29
32
33
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5

SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 80



SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 81

81



SOIL MAP OF GREENWOOD COUNTY, KANSAS – SHEET NUMBER 82

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 83

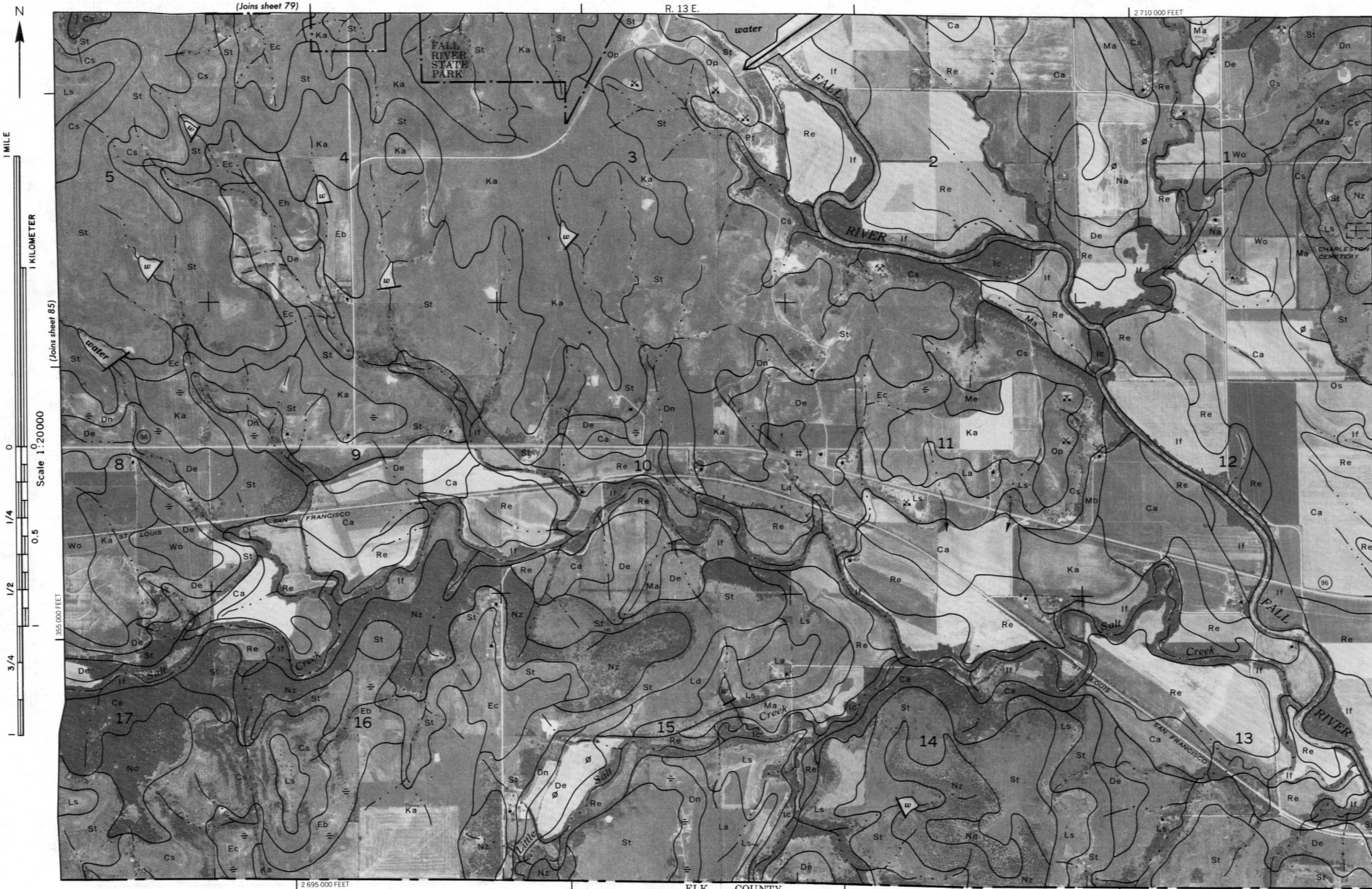
84

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 84

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 85

86

SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 86



SOIL MAP OF GREENWOOD COUNTY, KANSAS - SHEET NUMBER 87

87